The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. XXXVIII. April 16, 1938 No. 981

Physics in Industry

AN intriguing, though probably unprofitable, debate could be held upon the subject of the relative importance of physics and chemistry in the chemical industry. Engineering is applied physics and it is questionable whether a knowledge of chemical reactions or of physical phenomena is of the greater value in industry. Without a sound understanding of chemical reactions, chemical production could never begin except by rule-of-thumb methods, but without the application of physical principles, the production of chemicals could not be brought to the commercial stage. The debate, as we have said, would be unprofitable and the reason is that each is indispensable; physics and chemistry are handmaidens of industry who must ever walk side by side. It is this fact that gives to the reports of the National Physical Laboratory, the most recent of which is reviewed elsewhere in this issue, their fundamental significance alike to chemical manufacturers, to plant constructors and to chemical engineers.

Modern physics reaches out to the confines of matter in a manner that is paralleled by no other science. The transmutation of matter, dreamed of by mediæval philosophers, has become a scientific fact. The structure of the atom has been laid bare though no human eye is likely to see the atom itself, and still less the proton, the electron or the positron. The coincidence of matter and energy has been demonstrated so that it is known that a departure of energy must be accompanied by a corresponding decrease in the mass concerned. The many manifestations of matter in the form of radiation seem to be innumerable, giving rise to hertzian waves, to infra-red or heat waves, to light, to ultra-violet waves, X-rays and γ-rays.

It has been shown that the excitation of an atom into a state in which it can emit radiation is due to energy sufficient to remove an electron from one orbit to another, and since there are a number of characteristic quantities of energy concerned in these transitions we have been led to Planck's quantum, which is the amount of energy evolved divided by the frequency. In photo-electric phenomenon, on the other hand, the electron leaves the atom altogether, no precise quantity of energy being needed, provided that a certain minimum is exceeded. Modern physics also stretches out its hand "beyond the shining of the farthest star," and has, in the theory of relativity, given us a new conception of the structure of the universe which is still the subject of investigation among astronomers.

The National Physical Laboratory does not, however, conduct its work upon this high plane of speculation. One day, no doubt, the progress of applied physics will be able to turn some of these discoveries into commercial account—but not just at present. On the contrary, the work of the laboratory, as our account shows, is of vital importance in its immediate application to the problems of industry. The laboratory assists industry to solve its problems by advice and by experiment which may be carried out at the premises of individual firms, or at the laboratory; this is a service which should be generally known and used. The work is regarded as confidential, but the report stresses the need for those making use of the service to give to the N.P.L. the fullest possible information concerning the problem to be investigated.

The production of synthetic resins has been one of the primary researches of the Chemical Research Laboratory, and the N.P.L. is assisting in this work by determining the dielectric constants of certain of these bodies. Chemical engineers will find that the N.P.L. touches many of their problems closely. In the fatigue failure of mild steel, for example, it has been shown that when the applied stress is such as to produce fracture, severe fragmentation of the crystallites occurs and increases up to the moment of fracture; but when this fragmentation has been produced no further structural change occurs if the stress is below the value necessary to produce eventual fracture. The thermal conductivities of air and CO_2 up to 300° C. have been determined, and also of several solids and liquids. It is interesting to notice that phlogopite mica may show a decrease in thermal conductivity at 200° C. up to one-third of the initial value, due to displacement of the crystals from their ordered setting, whereas muscovite mica does not show this anomaly.

The development of static electricity in the dry-cleaning process which may lead to explosions, can be prevented by the use of certain soaps; it has been shown that the active constituent is not the soap, but the water, the function of the soap being to carry the water into the spirit. Fabrics have the property of removing the water from the solution and thus the solution decreases in conductivity and may again become highly charged, even to the extent of several thousand volts. The use of a soluble soap has thus been shown to be a valuable safeguard, but the soap should be added periodically so that the conductivity of the water never falls below about 11^{-11} mho per cm. The welded construction of pressure vessels has been investigated from the aspect of the conveyance of gases under pressure. This investigation is still in progress and involves the examination of containers made of plates $\frac{1}{4}$-in., $\frac{3}{4}$-in. $1\frac{1}{4}$-in. thick that have been forge-welded or fusion-welded by oxy-acetylene and electric welding methods. The study of the cracking of boiler plates is concerned with intercrystalline attack; this investigation will be reported upon shortly, but it is interesting to record that the presence of sodium silicate to which failure has been attributed, may be without influence.

Notes and Comments

The Empire Exhibition

ARRANGEMENTS for the Empire Exhibition at Bellahouston Park, Glasgow, to be opened by the King on May 3, are rapidly approaching completion. Except for the exhibition at Wembley in 1924/25, it will be the largest exhibition ever held in the Empire, and much of the Empire's industrial and manufacturing capacity will be represented, together with exhibits designed to show the progress of civilisation within the Empire in many of its different aspects. The exhibits of United Kingdom industries will occupy an area of a million square feet, and there will be some fifty to sixty pavilions erected by individual industrial firms and organisations. No fewer than fifteen Government departments will be represented at the exhibition. The United Kingdom pavilion will include four exhibition halls, one devoted to a Fitter Britain exhibit, and the other three to exhibits organised by the D.S.I.R., illustrating the part played by science and research in the three national industries of coal, iron and steel, and shipbuilding. Elsewhere in the exhibition, the Ministry of Agriculture and Fisheries and the Forestry Commission will stage displays showing some of the benefits research has brought to the agricultural, fishing and forestry industries.

Paint Testing by the Railways

THE wide variety of materials consumed by the railways in large quantities has necessitated the establishment of organisations to deal with the testing of purchased materials to determine whether they conform to specification, and to examine submitted materials in order to select those most suited for the particular purpose in mind. F. Fancutt, in a paper read before the Institution of Civil Engineers, gave an interesting account of the work of this nature done by the Paint Research Laboratory of the London, Midland and Scottish Railway Co. The importance of this work can be judged from the fact that the company spends over half a million pounds annually on painting, for the protection and decoration of its property. The work of the laboratory is divided into three sections, each with its own separate field of operations and its own individual staff. The main section is concerned with routine testing and control of supplies, and another section with the development of new processes, problems concerned with application, the control of trials and any special application problems. The third, the research section, concentrates on the solution of unusual problems and on the development of new materials and methods of test. An account of part of the work of the sections, described in Mr. Fancutt's paper, commences on the opposite page.

The Industrial Situation

LORD HIRST, the retiring President of the Federation of British Industries, reviewed the events of his term of office and made some pertinent comments upon the industrial situation at the annual meeting of the Federation held in London last week. Certain of the new empires had been eager to impress upon the world their strength and power and their desire to play their part in world affairs and, while we must take notice of it, Lord Hirst did not see that any demands had been made which could not be settled with diplomacy, so long as we were able to represent our strength economically, financially, and by armament. For that reason he disliked the many people who were inclined to panic and were already beginning to hoard money and change their normal habits of life. It was their attitude that affected the Stock Exchanges and money that should normally flow into industry and employment lay dormant in the bank. He saw no slump in front of us, although at the moment our prosperity had received a recession due to this psychological effect deriving from world affairs. He pointed out that we had never had more people in employment than we had to-day and the spending power of the country was great. The belief that a slump must happen when the armament programme was finished was a great fallacy in the mind of the public. He did not believe that rearmament would finish in five years' time and the actual effect upon industry as a whole of the rearmament orders was more moderate than it appeared at first sight. He agreed with the desire that trade should become more international and if other big nations, particularly those with abnormally high tariffs, came to our way of thinking, they would find us ready co-operators.

India's Import Trade

INCREASED imports of chemicals into India are shown in a survey of the country's import trade for the nine months ended December 31 last, prepared by the Department of Overseas Trade. In an appreciable increase in imports of merchandise of Rs.40 crores, which was spread over a fairly wide range of commodities, the aggregate trade in chemicals and chemical preparations expanded from Rs.184 lakhs to Rs.251¼ lakhs. Of the three products for which particulars regarding the country of origin are available, substantial increases in imports of sodium carbonate and caustic soda from the United Kingdom were registered, while the imports from other countries decreased. There was an expansion of the aggregate trade in drugs and medicines from Rs.147 lakhs to Rs.170 lakhs and the increase of imports in dyes was marked, being from Rs.170 lakhs to Rs. 276 lakhs. The great bulk of this latter trade is in the hands of Germany, whose sendings advanced by more than half as much again, imports from the United Kingdom advancing from Rs.24 lakhs to Rs.27 lakhs. There has been little change in the trade in paints and colours.

Attack of Micro-Organisms on Casein-Wool

THE increasing interest being taken throughout the world in synthetic wool-like materials obtained from casein has caused the product to be subjected to close examination as regards its physical qualities, resistance to wear and general suitability as a practical textile material. For this purpose, it has been tested by the usual technique adopted in examination of textile fibres, but, it is pointed out by Smit and van der Heile in a letter published in last week's issue of *Nature*, due consideration should be given to the question whether these products can withstand biological agencies in the form of organisms able to assimilate and mineralise protein substances of the class to which casein belongs. The authors have found that nearly all casein-splitting micro-organisms, isolated from soil or manure, or gathered by infection from the ordinary atmosphere, are able to attack the wool. Many of the organisms show a very strong dissolving action. When grown on water-agar plates containing the usual inorganic salts and finely divided casein-wool threads these organisms invariably act by an exo-enzyme, so that a fairly large zone is developed around their places of growth, where every thread of casein-wool is dissolved.

Testing and Applying Paint

The Work of the Paint Research Laboratory of the L.M.S. Railway

THE general practice to-day is to base paint specifications on considerations of the paint's chemical composition, said Mr. Frank Fancutt, F.I.C., A.M.I.Chem.E., in a paper on "The Work of the Paint Research Laboratory of the L.M.S. Railway" read before a meeting of the Institution of Civil Engineers. Although such a practice has in the past worked quite satisfactorily, modern developments in paint manufacture have so increased the range of raw materials that the possibility of an alternative basis for specifications is being explored. The various components of the paint are all controlled by specifications both as to quality and quantity. The thinners, the oil, and the pigment are all estimated, and their quality individually tested. Certain properties of the paint are ill-defined, and are controlled by reference to a standard pattern. Such properties are:—Opacity, spreading rate, covering power, consistency or stoutness, ease of application, gloss, flow, colour, and fastness of colour to light.

Many other properties are also determined and include the determination of the weight per gallon, which serves as a ready check on formulation. The fineness of all paints, except those containing flake pigments such as aluminium, graphite, and micaceous iron, is such that all particles are required to pass completely a standard 200-mesh Institute of Mining and Metallurgy screen. The drying time is also closely watched and required to fall within narrow limits. Specific tests are conducted on such properties as resistance to acids in connexion with paints to be used on stations and with varnishes, etc., which are likely to be washed with acid cleaning-solutions. Tests for resistance to alkalies, cleaning or burning oil, or any other active agent are included where required. Certain types of finishes, notably varnish and enamel, are also tested in respect of elasticity, adhesion, and hardness. Thus the interests of the using departments of the railway are safeguarded to the fullest extent, and only those materials which are suitable for a particular purpose are recommended for use.

Chemical versus Physical Testing

Paint should be possessed of the requisite adhesion, have the necessary strength to stand up to traffic conditions and abrasions, and, in addition, be impervious to moisture. These properties cannot be determined by chemical means. It has, therefore, become necessary to study the physical properties of films in order to safeguard these interests. The adhesion and film strength is taken care of by such instruments as the tensile strength and percentage-elongation machine, the hardness by various types of apparatus which will measure hardness in relation to standard abrasives, and the flowing properties by the Plastometer and the Hoppler Viscometer. These tests are now being rapidly developed, but the main difficulty is concerned with the method of producing films; and it has been found that the one giving most consistent results is to spin paints of regulated viscosity on a turntable revolving at a constant speed. Paint is applied to a tin plate coated with mercury to form an amalgam surface, and by this means it is possible, when the film has become dry, to detach it without difficulty. Measurements are then taken by means of the vibrating reed spherometer to ensure that the actual test pieces are of consistent film thickness.

The following facts are of interest:—(1) A varnish film is of the order of 1/500 inch thick, and is capable, even after 3 or 4 months' ageing, of stretching to double its original length; (2) Synthetic resin varnishes have very much higher tensile strengths than ordinary fossil-gum varnishes, and celiulose lacquer films are even stronger; (3) It requires 800 grams of coarse carborundum powder falling through 6 feet to wear away a cellulose lacquer film 1/1,000 inch thick.

In addition to the work on physical testing, an investigation is proceeding with respect to accelerated weathering. The accelerated-weathering machine which has been installed in the Laboratory for 5 years consists of two carbon-arc lamps, which are suspended at the end of two arms which slowly revolve horizontally in a tank of 5-foot diameter. At right-angles to the arms carrying the arcs are two water sprays, which also rotate. On a rack round the inside of the tank are stood steel panels which are painted with the samples under test. The paints are thus exposed to ultra-violet light, and, at will, to water sprays, which simulate the sun and rain respectively. Approximately 5 weeks in this machine are equivalent to 12 months of normal weathering. The panels are exposed to light alone, light and water, and water alone, in a predetermined cycle. The effect of frost is obtained by placing the panels in a refrigerator at intervals, and the effect of various types of polluted atmospheres are reproduced by placing the panels in glass tanks into which the corrosive element has been introduced as a very fine mist. The type of breakdown obtained in the accelerated-weathering tests resembles very closely the type of breakdown experienced in service, but further experimental work is needed before implicit trust can be placed in the results. The possibility of designing a compound machine capable of imposing all these tests on the specimen automatically is now being considered, and it will be readily appreciated that the system of paint control would be radically altered if the use of such a machine, in conjunction with the determination of physical properties, made it possible completely to evaluate a paint in a few weeks.

It may be of interest to note that much of the apparatus used for the determination of these physical properties of paint films is being made in the laboratory workshop, since none of the apparatus at present available is generally adaptable to the problem. This is particularly instanced in the case of a constant-speed mandrel apparatus, and it may be said that this is the only apparatus of its type at present available.

The Development of Paints

Many oils besides linseed oil, have the property of forming an elastic coherent film on drying, and among them is tung or China wood oil. It is being increasingly used, giving a film less permeable than linseed oil, but, unless carefully and specially treated, not so durable. Oiticica, perilla, and soya bean oils are finding increasing use. In addition to these, fish oils are also used, but they are semidrying oils, and their addition in large quantities to any paint slows up the drying considerably. The addition of driers to a paint is critical, an excess will prevent the paint from drying and will cause cracking of the paint film.

Classification of pigments is difficult, since they fall into no clearly defined classes except that of colour, and it is usual to use this somewhat arbitrary system of classification, in which the group of white pigments is the most important, since white paints, and nearly all light-coloured paints, contain them. The chief members are white lead, zinc oxide, lithopone, and titanium oxide pigments. White lead was indisputably the best white pigment available until recent years. It has several disadvantages; it is not only readily acted upon by industrial atmospheres generally, but specially when sulphuretted hydrogen is present. Wherever salt water spray comes into contact with it action quickly ensues, resulting in the complete destruction of the paint. The film of white lead paint is soft, and so is liable to physical damage; it is also very prone to collect dirt, and has a tendency to "chalk." Zinc oxide is remarkable for its brilliance of colour, but its opacity is slightly less than that of white lead. It is non-toxic, and is not discoloured by industrial atmospheres. It forms paints of good durability, and of higher gloss than those containing white lead. The brush marks are not so pronounced as with lead paints, and the film is harder and less liable to retain dirt. Leaded zinc-oxide paints combine to

some extent the properties of the lead and the zinc oxide paints, and have excellent durability. Lithopone is of exceptional opacity but of poor durability, and not recommended for exterior use.

Titanium white is a new pigment of considerable value, particularly as regards opacity; its use has made "one coat" enamels and paints a feature of modern paint technology. It is a particularly inert pigment, and invaluable where it is necessary to obliterate the surface to which it is applied. Oxide of iron pigments give paints of very good durability and films possessing a high degree of impermeability. Red lead paints are rarely used for decorative purposes, because they are difficult to apply and change colour fairly rapidly on exposure. The virture of the pigment in priming paints appears to be due to the fact that it assists the formation of a protective film of oxide on the metal. There is no doubt that red lead definitely has some rust-inhibitive action, a property shared by chromate pigments, such as lead chromate and zinc chromate. The main difference between graphite paints and other paints is, that graphite is a conductor of electricity and is cathodic to iron and steel, and, therefore, liable to promote corrosion. Mixed, however, with red lead and other extenders, a paint of excellent properties is obtained. The flakes of the graphite overlapping in the film result in a particularly impermeable coating. Metallic lead, aluminium, antimony, and zinc pigments are used in certain proprietary paints. The metal acts anodically to iron and steel, and so prevents its corrosion. It will be seen, said Mr. Fancutt, that few, if any, pigments possess all the desired properties, and modern paints almost invariably contain mixtures of various pigments.

The volatile thinners commonly used are white spirit or petroleum distillate and turpentine. Turpentine is a better solvent for the gums which are used in varnishes, and which are sometimes added to paints to give a better adhesion and decrease the permeability. It is also a solvent for the lead soaps which are formed in white lead paints, and for this reason should be used alone or in conjunction with white spirit in such paints. In most other cases white spirit is quite equal to turpentine.

Synthetic Painting Materials

The two types of synthetic resins in extensive use in paint manufacture are phenol formaldehyde resins, and alkyd, or glyptal resins. Sometimes the resins are combined with the fatty acid of a drying oil, and in this way paint vehicles of exceptional properties are produced, which are chemically stable and represent the greatest advance in paint technology of recent years. These materials may be used as varnishes, or pigmented to make paints and enamels. The advances in raw materials used in paint manufacture have been matched by technical advances in the mixing, grinding, and homogenising machinery.

Numbered amongst the new products of the paint industry are sulphonised oil paints. Linseed or tung oil is acted upon by sulphur, and the resultant product emulsified in white spirit (in which the sulphonised oil is insoluble). Paint made from this medium can be applied in successive coats, "wet-on-wet." Five or six coats can be applied in 1 day, and the whole film dries as a unit. The sulphur causes the gelatinisation of the film normally brought about by oxidation. The paints are fairly durable, but appear to be somewhat lacking in adhesion.

Although cellulose lacquers have been found to be adaptable to certain industries, they have not been successful for exterior painting so far as railways are concerned; a realisation of this, in conjunction with the advantages offered by synthetic resins, led to an investigation being carried out with the object of combining the desirable features of both, since, if this could be achieved, it would produce films of much greater hardness and toughness and, in addition, would fulfil one function which is so vitally important to-day, namely, the speeding up of painting processes. Considerable laboratory work was carried out, and it was found that the idea was generally adaptable to modern paint-manufacturing technique, and the material was produced experimentally, and having satisfied all the tests applied to it in the laboratory, was eventually utilised in the painting of locomotives and carriages.

Bituminous paints have been improved by processing the bitumen in order to produce a more tough film. In addition bituminous emulsions are available, which have a high resistance to the fault known as "crocodiling." Chlorinated rubber gives a paint with excellent resistance to alkalies and acids, and recent improvements have resulted in an increased durability.

Preparation of Steel for Painting

After considerable experimental work it was found that, for steel panelling as used in carriage construction, the best results were obtained in the initial treatment of the metal prior to receiving the first coat of paint by washing the surface with a solution which was styled "panel wash." The panels are purchased free of mill-scale and are covered with a non-drying mineral oil at the maker's works. After the removal of the oil at the company's depots, the panels were found to be liable to corrosion due to handling with hands moist from perspiration, and the panel wash was designed to meet this difficulty. The action of the wash is fourfold; it removes last traces of the mineral oil, dissolves any rust present, and by its chemical action gives a mild rust inhibitive effect, and also etches the metal, providing an ideal surface for the adhesion of paint. The formula of the "panel wash" at present accepted as standard is methylated spirit, 80 per cent. by volume, and orthophosphoric acid (concentrated), 20 per cent. by volume

The problem with regard to the sheet used for the construction of locomotive tenders was a somewhat different one, since these sheets are much more heavily coated with mill-scale, which is firmly adherent and cannot be effectively removed by such a treatment. It was found that shot-blasting produced an ideal condition for receiving the first coat of paint, and is in use to-day on a fairly extensive scale. In conjunction with this, flexible disks coated with very coarse carborundum paper were also tried, and these were found equally promising and had the advantage that the plant could be transported to any position in the works, which is not possible when shot-blasting is employed.

Consideration was also given to after-care and maintenance of the painted surface in an effort still further to extend the known durability of paint films on railway rolling-stock running under normal conditions. Two types of waxing composition are in general use, one being applied to rolling stock immediately after it is varnished in the works as a preparatory treatment before the vehicles go into service. The composition used in this case is as follows:—Ceresin wax, 16 per cent.; calcium stearate, 10 per cent.; petroleum, 30 per cent.; mineral cleaning oil, 44 per cent.

This composition is intended as the initial protection to the varnish, but its cleaning properties are such that it will not function satisfactorily when the paintwork becomes coated with traffic grime. It is, therefore, necessary to incorporate a mild abrasive for this purpose. A typical formula of the wax cleaning composition is as follows:—Abrasive powder, 33 per cent.; calcium stearate, 3 per cent.; ceresin wax, 7 per cent.; oxide of iron, 2 per cent.; carbolic acid, 0.5 per cent.; petroleum, 53 per cent.; ammonia (concentrated), 1.5 per cent.

A typical example of a universal stripper, which has been evolved and has been covered by British patent rights, comprises the following:—Ceresin wax, 7 per cent.; benzol, 21 per cent.; methyl alcohol, 20 per cent.; ethylene dichloride, 32 per cent.; acetone, 20 per cent.

De-Scaling Methods

Weathering is the method most commonly adopted in de-scaling. Careful investigation has shown, however, that under modern conditions the de-scaling by weathering is often incomplete, and that at least 6 months' weathering is required to remove all mill-scale. The practice of removing scale completely is essential if corrosion is to be avoided. So far as

the L.M.S. Railway is concerned, the de-scaling and preparation of metal for painting is carried out with the utmost care, and often the cost of preparing the metal far exceeds the cost of painting it.

De-scaling by pickling is the method which has most to recommend it, continued Mr. Fancutt, and recent improvements introduced have revolutionised the whole problem. One method in particular which has been adopted by a large industrial concern, has proved very successful, and is considered of sufficient interest to justify the details of the method being given here. The steel is first de-scaled in a 5 per cent. sulphuric acid bath maintained at a temperature of from 60° to 65° F. When the plates are completely de-scaled, they are washed in hot water, and finally immersed for from 3 to 5 minutes in a 2 per cent. phosphoric acid bath at a temperature of 85° F. They are then primed while still warm from the bath. The cost has been calculated to be less than ¾d. per square foot, and the results obtained are excellent. Other methods of pickling employ hydrochloric acid, sulphuric acid, or phosphoric acid used alone, sometimes followed by washing in a neutralising bath of lime; the plates so treated are generally liable to re-rust very quickly, a tendency which is checked by the use of the method given above.

Sand-blasting, shot-blasting, and grinding are the mechanical methods most favoured, with such variations as shot- and sand-slinging, tumbling, etc. A method which has a limited application but which is much favoured in certain trades is that of stretching. The scale-bearing metal is stretched about 10 per cent. of its length, the scale being almost completely detached by the process.

Discussion

Mr. MAURICE WILSON spoke of the work of a Committee of the Institution of Civil Engineers which has been studying exposure under sea conditions and the permanence of paints in these circumstances. Generally speaking, it was found that either red lead or white lead paints were better than iron oxide, although there was not a great deal of difference between them, but chromate paints had been found to be quite promising. Bituminous solutions were found to be very good especially in the half-tide and under submerged conditions, but these solutions were not very good in the case of the specimens which were fully exposed to the atmosphere. The general results of the experiments, which however would not apply to railway carriages, was that the best and most reliable results were obtained with tar compositions, although for certain purposes red and white lead paints gave excellent results.

Dr. L. A. JORDAN (Director, Paint Research Station, Teddington) after congratulating the author on the work he was doing at Derby, said that the railway companies were not members of the paint research organisation at Teddington, but that was not the fault of the railway companies. It was due to the constitution of the Research Station organisation which did not provide for the user element and personally he thought this was a very great pity because there was no doubt about it that it was only possible to get information as to the life of a paint after it left the manufacturer. It had been well said that it did not matter what was in the tin; what mattered was what was done with it. He commended this to many people when, as so often happened, they were faced with disappointment in the use of paints. There was more than a substratum of truth in this and the author had demonstrated how necessary it was to pay attention to the condition of the surface to which the paint was applied and the manner in which it was applied because only in that way was it possible to arrive ultimately at a satisfactory formulation of the paint. He recommended to paint manufacturers and others a close study of this part of the paper.

Mr. PETERS said it was astonishing that thousands of pounds should be spent in order to improve the quality of both ferrous and non-ferrous metals used in railway work of various descriptions and that such a relatively small amount of attention should be paid to maintaining the surface of these materials when in use. Therefore, the L.M.S. was to be admired for having established its Paint Research Laboratory and at the same time it was to be congratuated on having obtained such a qualified technologist as Mr. Fancutt to take charge of it. Referring to the statement in the paper that one of the essential features of the composition of paint is a pigment which not only provides the colour and gives the property of opacity to the paint, but also imparts certain other physical and chemical properties to the film, Mr. Peters asked the author what he actually meant by that. He also expressed disappointment that the author had not gone into greater detail with regard to pigments, especially in relation to those liable to promote corrosion. He further inquired why the author had come to the conclusion that turpentine was better than white spirit, and also why it was that cellulose lacquers, although they had proved tremendously popular for the painting of motor car bodies, had not been successful for exterior painting so far as railways were concerned.

The AUTHOR replying to the discussion said it seemed to have been agreed that the real criterion of any painting job, apart from the actual quality of the paint, was the preparatory treatment of the surface. Replying to Mr. Peters as to why he considered turpentine better than white spirit, he suggested that Mr. Peters as a paint manufacturer could answer that question very much better himself. However, in speaking of turpentine and white spirit he was not so much concerned with the manufacture of them as with the materials as they were handed over by him to the people who had to apply them, and experience had proved that where dilutions were necessary it was much better to use turpentine than white spirit because the affinity of turpentine for natural gums was very largely removed in the case of white spirit. With regard to the use of cellulose lacquers under railway conditions and their greater use in the motor car industry, he said he believed that the motor car industry was going away from cellulose lacquers. It certainly was in America if not in this country, and he visualised the day being not far distant when cellulose would have been superseded by synthetic materials of the bakelite type. The railway companies had many vehicles sprayed with cellulose materials and the difficulty had been that these films would not stand up to the strains and stresses met with on ordinary locomotives and carriages. In conclusion, Mr. Fancutt said that it was a matter of great satisfaction that paint was now being watched and investigated in a manner quite different from what had been the case in the past.

A Highly-Adsorptive Bentonite

Extensive Canadian Deposit

The characteristics of a Canadian bentonite of unusually high adsorption efficiency have been studied by Gallay (*Can. Jour. Res.*, 1938, *16*, 6-34). Bentonites from various parts of Canada were examined, in comparison with numerous other samples from the U.S.A., Germany and France, for their ability to bleach lubricating oil distillates, tallow and soap, etc.

Of the Canadian earths, a specimen from Morden, in Manitoba, obtained from an extensive deposit estimated to contain six million tons, was found to be an exceptionally efficient adsorbent, being much better than all the comparison samples examined. The average analysis of this earth was 51 per cent. silica, 24 per cent. alumina, MgO 0.3-0.8 per cent., CaO 0.6-0.8 per cent., total loss on ignition 25 per cent. The silica-alumina ratio is slightly less than in a normal fuller's earth, while the combined water is very much higher (normal figure is about 15.6 per cent.), a fact which probably has a good deal to do with the enhanced adsorption efficiency. Before use, the bentonite was activated by treatment with sulphuric acid, followed by washing, and drying at 200° C.

Dyeing Difficulties and Faults

A Symposium held by the Manchester Section of the Society of Dyers and Colourists

A SYMPOSIUM on "Dyeing Difficulties and Faults" was held at the monthly meeting of the Manchester Section of the Society of Dyers and Colourists on April 8.

Mr. J. D. BLAKELEY mentioned two interesting faults. Some grey cloth containing azoic black stripes was mercerised and bleached. The finished goods had a definite yellow appearance which could not be removed by chemicking, but was removed easily by soaping. The fault was traced to fatty matter in the finish which had dissolved and spread some of the azoic colour. In the second case some heavy coloured striped cotton cloth was coated with rubber on one side and made into a bag. Most of the striped colours were pale ones but there were two dark ones—a dark brown and a black—both vats. In contact with the dark stripes the rubber apparently had rotted away. No dangerous metals could be found. Finally, it was concluded that the two shades had been dyed from grey yarn, and that the rubber had not adhered to this grey yarn, so that the weakened rubber layer blistered and was damaged by friction.

Mr. C. CHILDS, referring to patchy or uneven dyeing, which sometimes occurred when dyeing azoic colours, remarked that while this might be due to many causes, the factors most likely to be responsible were as follows:—(1) Aeration of the Brenthol, due to long standing in the wet state after impregnating and before development. (2) Effect of acid, or chlorine vapours, or of direct sunlight on the Brentholated material while in the wet state. (3) Excessive acidity of the developing bath, which slowed down the speed of coupling. (4) Insufficiency of developer in the developing bath. (5) Inefficient preparation of the material prior to impregnation resulting, say, in the formation of lime soap deposits.

Brenthol Dyestuffs on Viscose Taffeta

He had occasion recently to investigate the cause of unlevel dyeing occurring with Brenthol dyestuffs on a viscose taffeta which was for subsequent use as an umbrella cloth. Application of the Brenthol was carried out on the jig, followed by mangling and jig development. This might be regarded as quite a normal procedure for average type fabrics. However, in this instance, the results were very streaky indeed. It was found that this was due to the construction of the particular type of cloth being such that it would not permit the developer to penetrate adequately. As the cloth was somewhat "reedy" the developer penetrated the material to some extent where the warp threads were spaced more widely apart, thus causing a certain amount of coupling, but where the warp threads were more tightly packed the developing liquor was resisted almost completely. As would be expected, this resulted in an extremely "stripey" appearance. This defect was overcome satisfactorily with subsequent dyeings by transferring development from the jig to the pad.

Mr. H. R. HEAP stated that when dealing with viscose, either spun or filament, it was always advisable to remember that the fibre had a great affinity for acids, which, if not properly neutralised could affect the dyeing and also form resist places if dried in, due to formation of hydrocellulose. Some form of pH control was very useful. The pH of the water used for scouring, was a point worth watching. A slightly alkaline water prevented the formation of iron deposit on the cloth from the iron content of the water. The fatty or waxy component of size was another source of trouble, for unless this was entirely removed faulty and uneven penetration might result and lead to streaky dyeings. Often it was advisable to add solvents to the scouring baths to remove the last traces of fatty matter. The scouring process could quite often be a source of trouble, due to lime soap formation causing white resist places.

Mr. R. HUMPHRIES said that the probability of finding a true solution to the many and varied problems presented in connection with dyeing difficulties and faults depended, firstly, on the condition of the sample received, and also upon whether subsequent processes or treatments had removed all direct evidence of the cause of the fault. In such cases, the opinion was bound to be formulated on circumstantial evidence. Secondly, there was the amount and the information given about the sample; thirdly, the knowledge and experience of the investigator, who must use his imagination and fill in such gaps as often unavoidably occurred, and upon his resourcefulness in devising such confirmatory tests as bore directly on the question at issue. It might sometimes occur, however, that on all possible information obtained and tests carried out the investigator might find it unwise to be too dogmatic in his final opinion.

Chemical Matters in Parliament

British Glycerine Manufacturers, Ltd.

IN the House of Commons on April 7, Mr. G. Strauss asked the Home Secretary why investigation has recently been made by his Department into the affairs of the British Glycerine Manufacturers, Ltd.?

In reply, Sir S. Hoare said the investigation was made by the police at the request of the Home Office in connection with the case of an alien concerned in the company, which is under consideration.

Mr. Strauss then asked if investigations would be made into the political connections of this company as well as into its financial aspects, in order to ascertain whether this company and the group of companies connected with it is not a centre of Nazi propaganda and espionage in this country?

In reply, Sir S. Hoare said that a full investigation is being made into all the circumstances.

Trade Marks Bill

On April 8, Captain Wallace moved the second reading of the Trade Marks Bill, which has already passed through the House of Lords. It consolidated the Bill of last Session with the earlier Trade Marks Acts of 1905 and 1919. Provided there were no objections to the proposed rules it was hoped to bring the new Act into operation on July 1.

The Bill was read a second time and committed to a Committee of the whole House.

Law of Patent and Design

On April 8 Captain Wallace moved the second reading of the Patents, etc. (International Conventions), Bill, which has already passed through the House of Lords. He said that the purpose of the Bill was to make a number of amendments in the patent and designs, trade marks, and merchandise marks law in order to enable the Government to give effect to two international conventions in the form in which they were revised at the London Conference of International Union for the protection of industrial property in 1934, and to deal with certain matters affected by those conventions.

Sir S. Cripps said that the Opposition had no objection to the Bill as a whole. There had been a good deal of complaint that in the past the man responsible for an invention had not received scientific credit for it. The extremely elaborate procedure laid down was unnecessarily complicated and liable to lead to a good deal of dispute and discussion which was undesirable and a waste of everybody's time and money.

The Bill was read a second time.

Applications of Physics to Industry

Annual Report of the National Physical Laboratory

A REVIEW of the more important researches in progress during 1937 is given in the annual report of the National Physical Laboratory, published by H.M. Stationery Office (2s. 6d.). The executive committee are gratified to note that the report for the year 1936, which appeared in a modified form, achieved a much wider circulation than has been recorded for previous years. The new form has accordingly been retained for the present report. Reference is also made to the proposal to issue in collected form abstracts of all papers published from the Laboratory each year. The first of these pamphlets, giving abstracts of the papers published during 1936, has now appeared, and this will shortly be followed by the corresponding collection of the 1937 papers.

In the physics department progress has been maintained in a variety of investigations dealing with the thermal conductivities of gases, liquids, and a range of solid materials including steels, aluminium alloys, mica and building materials. Work for the Food Investigation Board has dealt with a diversity of investigations of industrial utility. In connection with the International Temperature Scale, the work on the higher-precision realisation of the scale between 660° C. and 1,063° C. by means of the platinum thermocouple has made notable advance. The methods developed for the investigation of the temperature of liquid steel in the open-hearth furnace under works conditions give promise of solving a very troublesome problem. In the field of radiology, the report which follows indicates a healthy and steady growth in the applications of X-ray crystal analysis to industrial problems.

Thermal Conductivity of Gases and Liquids

Results have been obtained on the thermal conductivity of air and carbon dioxide at temperatures up to 300° C. For both gases the experimental results proved to be slightly higher than the values deduced from the kinetic theory of gases, which asserts that the conductivity bears a constant ratio to the product of the viscosity and the specific heat at constant volume. Conductivity determinations have also been made at temperatures up to 220° C. for the refrigerant dichlorodifluoromethane, commercially known as "Freon," but in the absence of data on viscosity, the law mentioned above cannot be tested. Among the liquids of which the thermal conductivity has been measured are several refrigerants, and various oils used in the process of quenching steels. The last-mentioned tests form part of a more general investigation of the physical properties of their oils, intended to throw light on the convective processes occurring when steels are quenched.

Work is in progress on the measurement of the thermal conductivity of a series of steels up to a temperature of about 900° C., and of a series of aluminium alloys up to 300° C. A survey has also been made of the existing published data on the thermal and electrical conductivities of irons and steels, with special reference to the variation with temperature of the relation between these quantities. It thus appears that when the thermal conductivity, K, is plotted against the product of the electrical conductivity, σ, and the absolute temperature, T, the majority of the points fall within about 10 per cent. of the line represented by

$$K = 0.625 \times 10^{-8} \sigma T + 0.006.$$

Considerable departures occur, however, for cast irons containing carbon in the form of graphite, and for a certain variety of stainless steel.

Work is still in active progress on the thermal properties of a series of 21 steels, including plain carbon steels, and others containing nickel, chromium and other metals. The electrical adiabatic method has been used for measuring both the specific heat up to 900° C. and the heat absorption at the transformation points. A repetition of the work on the latent heat of aluminium, using an exceptionally pure sample contained in a sintered alumina crucible, has shown that the anomalies reported earlier were due to impurities. Under the improved conditions the melt is perfectly sharp, and the latent heat is found to be about 94 calories per gram. It appears certain that the group of previous workers who recorded values of the order of 75 cal. per gram. must have used specimens containing impurity, probably iron, so that the marked increase in specific heat which they found near the melting point can no longer be accepted.

Evaporation Rate from Moistened Surfaces

Investigations are being continued on the evaporation of water from moistened surfaces. Work is in progress to ascertain how the rate of evaporation from a plane surface moistened on one side depends on the position in which it is set with regard to the wind stream. In the case of settings normal or parallel to the direction of the wind stream, the rate of evaporation produced by unit vapour pressure difference at a particular wind velocity is greatest when the surface faces the wind, and least when it is in the reversed position. It has been shown that appreciably higher rates of evaporation can be obtained by taking advantage of the turbulence induced in the air on the downstream surface of the plane when the latter is inclined at an angle to the wind stream. Thus a square surface of 19.5 cm. side, set at 30° to the direction of a wind stream having a velocity of 450 cm. per sec., and moistened on the surface facing downstream, is found to have a rate of evaporation some 50 per cent. in excess of the rate obtained when the moistened surface is facing and normal to the wind stream.

In conjunction with the Chemical Research Laboratory, an investigation of the transition of certain phenolic alcohols from the crystalline to the resinous state is in progress. In the course of X-ray studies of *p*-cresol monoalcohol, a crystalline product intermediate between the initial crystalline and the final resinous substance was found. This chemical compound was subsequently identified by chemical methods. In the resinous state the structure resembles that of the intermediate crystalline product, and is essentially a highly distorted form of this structure.

In addition to its use in conjunction with X-ray investigations, the method of electron diffraction has been employed in the study of corrosion products, in co-operation with the Chemical Research Laboratory. In studies of the atmospheric corrosion of iron, it is found that at temperatures about 200° C. the outer layers always consist of the trigonal ferric oxide, while at lower temperatures the structure is a cubic one which may be either the ferrous oxide or the cubic modification of ferric oxide. This cubic form also exists in the lower layers of the corrosion products formed at temperatures above 200° C.

Dielectric Values of Resins

The materials examined during 1937 in the Electricity Department, for dielectric values, have included a group of synthetic resins, some typical glasses and various grades of ebonite. The work on synthetic resins has been carried out in conjunction with the Chemical Research Laboratory. The resins examined were all of the phenolic type, but they included thermoplastic resins as well as those of the heat-hardening class. Of the chemical factors investigated, the chief were the effects of preparing resins with cresol or xylenol, instead of phenol. The resins were examined in the pure condition, i.e., in the form of thin films deposited on metal, and also in the form of laminated paper boards. The electrical properties of the resins which have been studied in the form of thin films throw some light on the structure of the films. A paper on the subject was presented to a symposium on the structure of protective films, held by the London Section and Plastics Group of the Society of Chemical Industry and the Oil and Colour Chemists Association.

Static electric charges which are often generated by friction in the dry-cleaning of fabrics have been investigated still further. Special soaps have long been used in the dry-cleaning industry, partly for their cleansing properties, and partly because they were believed to prevent the generation of charges. Experiments made at the Laboratory in 1936 showed that the addition of such soaps causes a large increase in the electrical conductivity of the cleaning bath, but that during the process of cleaning the electrical conductivity tends to fall to the low value obtained when soap is not used.

Experiments carried out during 1937 have shown that, from the electrical point of view, the active constituent of the soaps is water, and that soaps not containing water have very little effect in preventing the generation of static charges. On the other hand, the addition to the bath of water alone has very little effect. The function of the soap is to carry the water into solution in the spirit. Fabrics have the property of removing the water from solution, thereby causing a fall in conductivity. By means of an experimental generator, charges were produced by friction on a cotton belt running between two pulleys, and when the belt was run in cleaning spirit, potentials of a few thousand volts were easily obtained. On the addition of a suitable soap containing water to the liquid, the potential immediately fell to zero, but tended to rise again as the water of the soap was absorbed by the fabric. The experiments clearly show that the use of a soluble soap containing water is a valuable safety measure, and that the soap should be added periodically, so that the conductivity of the liquid never falls below a value of the order of 10^{-11} mho per cm.

Testing and Standardising Glassware

The quantity of volumetric glassware received for test in the metrology department during 1937 showed an increase of 10 per cent. on the previous year, and was 80 per cent. higher than in 1933. The Laboratory has continued its collaboration with the British Standards Institution in the preparation of British Standard Specifications for volumetric glassware. During 1937 specifications were issued for graduated and straight pipettes, density bottles, centrifuge tubes for the determination of visible dirt in milk, hæmacytometer counting chambers and dilution pipettes, volumetric glassware used in the Babcock method of determining the percentage of fat in milk and milk products, and apparatus for the determination of small quantities of water by distillation with an immiscible liquid. In addition, work is in progress on specifications for Ostwald Folin pipettes, one-mark capillary pipettes, ordinary bulb pipettes, burettes and bulb burettes, and hæmoglobinometers. The Laboratory is co-operating with the Standardisation of Tar Products Tests Committee in the revision of the portion of their handbook dealing with glass apparatus.

The Laboratory has made arrangements for testing volumetric glassware for conformity with the British Standard Specifications. A considerable number of Gerber butyrometers and a certain amount of other apparatus have already been received for test under these arrangements.

The number of hydrometers received for test has remained about the same as in previous years. Density hydrometers for use in milk are beginning to come in for test for conformity with the recently issued British Standard Specification. A detailed specification has been prepared for a set of new, standard density hydrometers with subdivisions equivalent to 0.0002 g. per ml., and an order has been placed for these standards. A new method of standardisation is being developed which promises to reduce the time taken by this work to about one-half. The Laboratory is co-operating with the British Standards Institution in the preparation of density-composition tables for use with British Standard density hydrometers, and the first of these, for sulphuric acid, has recently been published by the British Standards Institution.

New researches commenced in the Engineering Department during 1937 included, welded construction for pressure vessels and pipe flanges and bolted connections.

An investigation has been undertaken, on behalf of the Gas Cylinders and Containers Committee of the Department of Scientific and Industrial Research, into the strength of welded construction for pressure vessels. For many years the Laboratory has given technical assistance to the Government departments responsible for safety regulations concerning the design and construction of cylinders and containers for the transport of compressed and liquefied gases, and has carried out investigations both on the properties of the gases and on various types of containers.

Fusion Welding for Pressure Vessels

Developments in chemical engineering have caused a big increase in the commercial uses of various liquefied gases, and for transport purposes it is apparent that improvements in cylinder and container construction which lead to reductions in weight, without relaxation of a necessary margin of safety, are of considerable advantage to the industries concerned. For large steel containers, some of which may be used to transport as much as 12 tons of liquefied gas in one vessel, forge-welded containers have been used hitherto in this country, an example of this type being the railway tank wagon used for liquefied chlorine. Forge welding, however, is not the only method of welding which can be used for the joints in these vessels, and consideration is being given to the modern methods of fusion welding now rapidly coming into use for both small and large pressure vessels.

To assist in this matter, an investigation has been undertaken at the Laboratory whereby a detailed examination will be made of oxy-acetylene welding and electric welding as applied to pressure vessel construction. Steel plates, $\frac{1}{4}$ in., $\frac{3}{4}$ in. and $1\frac{1}{4}$ in. thick, have been supplied to a number of leading British firms for the preparation of welded joints of the types used in pressure vessels; forge welding is included in the investigation, in addition to oxyacetylene and electric fusion welding. These joints will be subjected to mechanical tests and metallurgical examination at the Laboratory, and the results obtained should enable a comparison to be made of the relative merits of the three types of welding for the construction of welded pressure vessels of the highest quality.

An interesting new investigation has been undertaken as an extension to the current research into pipe flanges and bolted connections for use at high temperatures and pressures, with the co-operation of the Institution of Mechanical Engineers. The main investigation, which relates to the life of complete full-sized steampipe assemblies, is being actively continued, and should soon reach a second report stage, whereas the extension is concerned with a study of creep relaxation.

The liquefied petroleum gases propane and butane are now being brought into considerable use in this country for industrial and domestic purposes, and it becomes necessary to obtain data on those physical properties of the gases on which the safe design of the containers must be based. Experimental work has therefore been commenced on the variation of liquid density and vapour pressure with change of temperature, within the range likely to be met in practice. Samples of these gases, also of those mixtures which are normally used, will be heated under precisely controlled temperature conditions; from the resulting observations, the working pressures and safe filling ratios will be deduced.

Heat Losses from Bare Pipes

The determination of the heat loss from a bare pipe over an extended range of temperature up to 1,000° F. has been completed. This item of research arose from tests of the efficiency of steam-pipe covering materials, for which there has been a steady demand for many years. In describing the heat insulating properties of such covering materials, it is usual to express efficiency as the ratio of the saving in heat loss due to the presence of the cover to the heat loss from an uncovered pipe under specified conditions.

The rate of heat loss per unit area from such a bare pipe naturally depends on its surface condition and, to a less extent, on the material and size of the pipe: hence it is necessary to adopt some standard of bare pipe for comparison purposes,

and the standard used at the Laboratory is a length of normal steam pipe having a diameter of 4 in. This pipe was originally calibrated up to a temperature of 600° F., but in view of the demands received from industry for efficiency tests at higher temperatures, it was necessary to extend the calibration of the bare pipe to temperatures up to 1,000° F.: this has now been done, affording experimental data in place of the extrapolation formerly used.

Investigations of Alloys

In addition to the research work undertaken for the executive committee of the Laboratory, the Metallurgy Department has in hand investigations for the Metallurgy Research Board, the Iron and Steel Industrial Research Council, the British Electrical and Allied Industries Research Association, and other bodies. Direct contact with industry is maintained through these bodies and their associated research committees, which are charged with investigating problems of interest to particular branches of industry. It is worthy of note that as the work of these committees progresses, it is found increasingly necessary to give attention to questions of a scientific nature, such as the behaviour of alloys of the utmost attainable purity, which are not of immediate practical application, but serve to isolate some of the many factors involved in an industrial problem. This is particularly illustrated by the investigations on behalf of the Alloy Steels Committee of the Iron and Steel Industrial Research Council and the Iron and Steel Institute: these include the study of constitutional diagrams of alloys of iron, and of the heating and cooling curves of technical alloys in relation to their physical properties and microscopic structure.

The lack of commercially obtainable refractory materials for very high temperatures, having chemical resistance as well as strength, is perhaps the main practical difficulty in research in this field. During the year further experience has been gained in the preparation of highly fired alumina ware for the purposes of this and other departments of the Laboratory. Vessels of other materials, especially thoria and beryllia, which have to be used for some of the researches involving high temperatures, have also been produced. As a result of this work, particularly that on alumina, the design of an injector gas furnace suitable for the production of very high temperatures has been greatly improved.

Work on the improvement of magnesium alloys has been confined to a study of the effect of mechanical treatment on the properties of the alloys. It has been shown that with silver-aluminium-magnesium alloys of the type referred to in last year's report, considerably improved properties can be obtained by a double forging process, involving a first reduction at about 400° C. and a final reduction at about 200° C. Proof stresses of 20 tons per sq. in. and over have been obtained.

Constitution and Ageing of Al-Cu Alloys

Work on the constitution and ageing of alloys of aluminium containing 4 per cent. of copper to which small quantities of iron and silicon have been added, has now been completed and published. Remarkable anomalies have been found when alloys of this kind are prepared from aluminium of about 99.997 per cent. purity, which is now available, great difficulty in obtaining complete solution of the copper compound on heating being observed: the nature of these anomalies has been studied, and a paper on the subject has been presented to the Institute of Metals. No undercooling is observed in copper-aluminium alloys of this purity when rapidly chilled, but the macro- and micro-structures resemble those of commercial alloys in the undercooled condition. During the solution treatment, even when assisted by hot-working, the copper only passes with difficulty into solid solution, and it is necessary to employ cold-working in different directions to enable the alloy to be brought into a condition in which it will undergo age-hardening.

Another approach has been made to the age-hardening problem by means of the X-ray examination of single crystals of aluminium containing copper in solid solution. Certain effects, hitherto unobserved, have been noticed in the diffraction patterns of these crystals, and the interpretation of these is thought to throw much light on the mechanism of the age-hardening process.

Research on gas cylinders has been carried out chiefly for the Gas Cylinders and Containers Committee and the Home Office, in collaboration with the engineering department. Various materials have been under consideration, including carbon steel, 1.5 per cent. manganese steel, nickel-chromium-molybdenum steel, and an aluminium alloy. An investigation is now being conducted into the suitability of fusion welding of carbon steels to form containers for certain low-pressure noxious liquefiable gases, and for liquefiable gases such as butane and propane. A review has also been prepared on the properties of liquefiable gases, and an intensive study of the effect of prolonged service on high pressure cylinders containing certain of the permanent gases is in progress.

A detailed account of the methods adopted in the analysis of the residues obtained from steels by extraction with an alcoholic solution of iodine has been published in the Seventh Report on the Heterogeneity of Steel Ingots of the Iron and Steel Institute. Work has been continued on the effects of sulphur and phosphorus on the separation of the residue and on its analysis, and attempts have been made without success to separate the constituents of the unignited residue by flotation. Experiments have shown that the substitution of other organic solvents for methyl alcohol does not give satisfactory results. A new programme of work on the vacuum extraction method is in hand, with the object of extending to certain alloy steels the advantages already obtained with steels of simpler constitution.

Use of Flame Spectra

Some further work has been done on the use of flame spectra, and several forms of all-glass atomisers have been tried; the sensitivity has been shown to depend much on the details of the apparatus and on the conditions of operation. The procedure at present adopted allows lines due to nickel, for example, to be detected after five minutes exposure, with a flame to which about 1 ml. of a 0.01 per cent. nickel solution has been supplied as spray. The method should be valuable in the analysis of alloys and "pure" metals, since it does not require the preliminary preparation and analysis of a series of samples of graded composition, for the spectrum of an unknown solution may be matched by synthesis from aqueous solutions. The data necessary for quantitative analysis by these means are being accumulated.

With the object of setting up satisfactory standards for the quality of laboratory glass and porcelain ware, various tests have been carried out for a committee of the British Standards Institution. The work has consisted in determining the deterioration of different kinds of glass when stored under atmospheric conditions corresponding with those of the tropics. Several varieties of porcelain have been examined, with the object of devising a test which will allow of the setting up of a satisfactory standard. Several exhaustive analyses, using microchemical, spectrographic and ordinary chemical methods have been made on laboratory filter paper, in which the quantity of mineral matter is exceedingly small.

FACTORS influencing the corrosion of caustic soda fusion tanks have been examined by Ugo-Perret (La Chemica e l'Industria, 1938, No. 3, p. 133-6, who has revealed a more serious corrosion of the steel when using alkali made by the mercury cell process than when using the diaphragm process. This difference was traced to the presence of chlorates in the soda made by the diaphragm process. Addition of sodium chlorate to caustic soda derived from the mercury cell process resulted in a 90 per cent. reduction in corrosion while the life of the vessels was quadrupled. The chlorate is believed to exercise a passivating action upon the steel.

An Equilibrium Study of the System: Ethylene, Water and Ethyl Alcohol*

By
A. J. PAIK

THE initial purpose of this investigation was to determine the free energy for the vapour phase dehydration of ethanol at low temperatures. Previous investigations had shown that a low temperature was necessary as the decomposition into ethylene at high temperatures was so complete that the amount of ethanol remaining at equilibrium could not be accurately determined. The problem was at first a study of catalysts suitable for establishing equilibrium at low temperatures. It became desirable later to study the mechanism by which the most successful catalyst functioned.

Apparatus Employed

In the present investigation, the following apparatus was used. Ethanol was fed at a constant rate to a vaporiser coil in a heated glycerine bath and thence into the catalyst chamber. The vapours leaving the chamber passed through two traps, one cooled by salt and ice and the other by dry ice and acetone. Any condensible material was removed at this point. The non-condensible gases were measured by a wet test meter attached to the end of the train. A constant rate of feeding the alcohol was maintained by misplacing it from a burette with mercury, the rate of flow of which was controlled by a capillary.

The catalyst chamber was submerged in a large test tube with a side arm overflow. Glycerine was pumped into the tube from a thermostat by means of a motor driven oil pump. The thermostat was electrically heated and was held at the desired temperature by use of a mercury regulator system. The catalyst chamber was an annular space between two pyrex tubes sealed together at each end. Suitable entrance and exit tubes for the vapours were added. The vapours were fed into the bottom of the chamber allowing them to come to the temperature of the thermostat before contact with the catalyst.

The dehydration was first attempted with a series of nine aerogels of alumina or silica base. These were used both in the pure form and with manganese, boron, and phosphorus added singly and in combination. No reaction took place over the aerogels at a temperature of 175° C. or lower. The next series of catalysts was made by impregnating pumice with sulphuric acid to which were added compounds such as aluminium sulphate, lithium sulphate, boric acid, manganese carbonate, gold chloride, silver sulphate, and various combinations of these. The manganese oxide, boric oxide, phosphoric acid catalyst of Stanley[1] was also tried. Of these, the silver sulphate-sulphuric acid combination was found to be the best catalyst at 170° C., the Stanley catalyst being inoperable at this low temperature.

Mechanism of Ethanol Dehydration

At this point in the investigation it was decided to study the mechanism of the dehydration of ethanol over the silver sulphate-sulphuric acid catalyst in the hope of establishing a background for future selection of catalysts. The accepted mechanism for the formation of ethylene from ethanol and sulphuric acid is through the following steps:—

$$\text{A.}\quad C_2H_5OH + H_2SO_4 \rightleftarrows C_2H_5HSO_4 + H_2O$$

$$\text{B.}\quad C_2H_5HSO_4 \rightleftarrows C_2H_4 + H_2SO_4$$

Lommel and Englehardt[2] found that the reverse of reaction B was greatly aided by the presence of silver sulphate. The problem remaining was to ascertain the effect of silver sulphate on reaction A from both directions and on the decomposition of ethylsulphuric acid according to reaction B. Reaction A to the right was studied by making two identical mixtures of equivalent amounts of ethanol and sulphuric acil. To one of these mixtures silver sulphate was added. Samples were taken from each flask at definite intervals and were titrated. The amount of free acid was an index of the progress of the reaction. The reverse reaction was studied by the use of two series of sealed tubes placed in a thermostat. Each tube contained the same amount of ethylsulphuric acid to which was added water in the molecular ratio of ten to one. One series contained silver sulphate. All the tubes were placed in the thermostat at the same time, and corresponding tubes of each series were removed together at definite intervals. After cooling in an ice bath, aliquot portions of each tube contents were titrated, the reaction progress again being indicated by the free acid. The effect of silver sulphate on reaction B was studied by heating two equal portions of ethylsulphuric acid to 140° C. and collecting the ethylene formed. Silver sulphate was added to one of the portions.

Superiority of $AgSO_4$—H_2SO_4 Catalyst

It was found that no reaction took place over the nine aerogels at 175° C. This indicates that their large surface area as compared to that of crystalline catalysts is not the factor deciding their activity in this dehydration reaction. The silver sulphate-sulphuric acid combination was the best catalyst studied for the dehydration at the low temperature of 175° C. Attempts to promote the silver sulphate by adding other salts were unsuccessful. The second best catalyst was a mixture of 18.3 per cent. by weight of aluminium sulphate with sulphuric acid. The Stanley catalyst was unsuccessful at the low temperature of 175° C. both in solid form and impregnated on pumice with an excess of phosphoric acid.

Gold chloride and lithium sulphate were next in activity to the aluminium sulphate. This is interesting because of the grouping of the metals with silver in the periodic chart. It was found that the silver sulphate had no effect on the rate of equilibrum attainment of the system:

$$C_2H_5OH + H_2SO_4 \rightleftarrows C_2H_5HSO_4 + H_2O,$$

the study being made from both directions.

Catalytic Effect of the Silver Sulphate

The silver sulphate, however, had the effect of almost doubling the amount of ethylene formed over a given period by the reaction:

$$C_2H_5HSO_4 \rightarrow C_2H_4 + H_2SO_4,$$

This fact, combined with the results of Lommel and Englehardt, who showed that silver sulphate aids the absorption of ethylene in sulphuric acid, shows that the silver sulphate hastens the attainment of equilibrium in the system:

$$C_2H_5HSO_4 \rightleftarrows C_2H_4 + H_2SO_4$$

The results show conclusively then, that the silver sulphate-sulphuric acid catalyst does not promote the direct dehydration of ethylene. Instead, the ethanol forms the ester with the sulphuric acid, and the silver sulphate rapidly decomposes the ester into ethylene. Ipatieff[3] has shown that ethylene forms the monoethyl ester with phosphoric acid. It can, therefore, be safely deduced that the successful phosphoric acid catalysts function in like manner through the formation and decomposition of the ester.

REFERENCES.

[1] Stanley, Youell, and Dymock, *J. Soc. Chem. Ind.*, Vol. LIII, No. 28, pp. 205T-208T (1934).

[2] Lommel and Englehardt, *Ber. 57*, p. 848 (1924).

[3] Ipatieff, Preprint 71-27, *Electrochemical Society*, May (1937).

* Abstract of a thesis submitted in partial fulfilment of the requirements for the Ph.D. degree at the University of Illinois.

Society of Public Analysts

Election of New Members

AN ordinary meeting of the Society of Public Analysts and Other Analytical Chemists was held at the Chemical Society's rooms, London, March 6, with Professor W. H. Roberts, the president, in the chair.

The following were elected members of the Society: Ruth Bennett, B.Sc., G. J. Budds, J. G. A. Griffiths, B.A., Ph.D., A.I.C., W. J. C. Horne, J. E. Ritchie, M.A., B.Sc., F.I.C., M. J. Robb, B.Sc., F.I.C., G. H. Turner, B.Sc., F.I.C.

Certificates were read in favour of the following candidates for membership: D. C. E. Jenkins, M.Sc., F.I.C., R. G. Minor, A.I.C., R. K. Newman, B.Sc., A.A.C.I., R. W. Wallington, Ph.D., M.Sc., A.I.C.

Dyeing Properties of Henna

In a paper on the chemistry and analysis of Henna, Dr. H. E. Cox pointed out that contrary to some earlier literature henna does not contain tannin. The constituent to which its dyeing properties are due is 2-hydroxy-1 : 4-naphthaquinone. This substance, alone or in henna powder, can be very satisfactorily determined by means of a volumetric method and apparatus described, in which the quinone is reduced to trihydroxynaphthalene by a mercury-zinc amalgam in an atmosphere of carbon dioxide and after removal of the amalgam, titrated with ferric sulphate solution in presence of methylene blue as indicator. The dyeing of hair with hydroxynaphthaquinone is dependent on the *p*H value of the liquid. It requires an acid reaction and no satisfactory dyeing can be obtained in neutral or alkaline solutions. This is probably the reason why curious defects of colour sometimes appear in hair dyed with henna.

Character of Dusts Liable to Produce Silicosis

Microchemical investigations on siliceous dusts were reported by Dr. Janet W. Matthews, who gave an account of work carried out in collaboration with Professor H. V. A. Briscoe, P. F. Holt and P. M. Sanderson, the main object of which was to investigate the characters of dusts liable to produce silicosis. Two methods devised for collecting dusts from air in mines and factories, without contact with moisture, were described. In one method the air was filtered by suction through a layer of salicyclic acid crystals which were subsequently removed by solution in absolute alcohol; in the other method the air was passed through a long chamber ("labyrinth") divided by baffles into numerous compartments in which fractional deposition took place. It was found that siliceous materials are much more hygroscopic in the form of fine dust than in the macro-form, and that in the former condition an appreciable quantity of their silica becomes soluble in water. Dusts of calcined flint and asbestos, for example, which are dangerous in respect of silicosis, were found to yield 12 mg. and 30 mg. of silica per g. to 100 ml. of water, whilst cement and sillimanite dusts, which are regarded as innocuous in respect of silicosis, yielded only about 1 mg. The effect of the addition of other materials to the siliceous dusts was investigated, and it was found that admixture with an equal proportion of lime greatly reduced the quantity of silica dissolved by water.

WORK on the construction of three hydrogenation plants is expected to begin in France shortly, now that the necessary credits are to be granted. Each of the new factories will have an annual production capacity of 60,000 tons petrol. One of the plants will utilise lignite as raw material, the second anthracite and the third petroleum. Adequate supplies of lignite will be forthcoming from the deposits in the Department of Bouches-du-Rhône.

Metal Degreasing by Trichlorethylene

Range and Applications of I.C.I. Plants

THE removal of grease from metal parts by dissolving it in solvents is now standard practice in most large workshops and factories. This is largely the result of the flexibility, speed and economy given to the process by the range of degreasing plants now available for use with the powerful grease solvent, trichlorethylene. "Metal Degreasing by the I.C.I. Degreasing Process" (Imperial Chemical Industries, Ltd. 1st Edition, 1938. pp. 64. 3s. 6d. net) gives full details of the performance, operation and maintenance of the latest standard plants on the I.C.I. range, and should therefore be of great interest to both present and prospective users of the process. It also describes some of the special models designed to meet specific degreasing requirements.

There are three main types of plant: vapour, liquor-vapour and multi-liquor, each of which is available in several sizes. A valuable data sheet at the end of the book summarises the specifications of all these plants, and the details given of effective size, fuel and solvent consumption, and output should be of considerable help to a prospective user in the choice of a suitable unit. Detailed descriptions are given of the degreasing of typical articles in the different types of plant. There are working descriptions of the various plants illustrated by diagrams, heating media are discussed, the safety control devices for the prevention of overflow of vapour and overheating of solvent are described, and a section is included on the properties of trichlorethylene with some useful notes on the elementary precautions to be observed when using it in degreasing plants. An appendix discusses the chief points to be observed when installing degreasing plant and gives detailed instructions for the operation and maintenance of all standard types.

Although the standard plant range covers most degreasing requirements, the process has been brought to such a degree of flexibility that I.C.I. will design and supply special plants for particular requirements which cannot be adequately dealt with by any model on the standard range. There are some excellent full-page photographs which give a good idea of the range of application of some of these plants, which include continuous plants for use in conjunction with conveyor installations, plants for the continuous degreasing of strip, sheet metal, and cylinders and drums.

A batch of fifty-two Radicon worm reducers—all on one order—ready for despatch from the works of the manufacturers, David Brown and Sons (Hudd.), Ltd. They are fan-cooled, totally-enclosed units and secure a large range of speed ratios between the prime mover and driven machine. There is automatic and positive lubrication to all bearings and gears. The units shown in the photograph are of three different geared motor types—for horizontal drives at right angles, with the wormshaft arranged above and below the wheel respectively, and self-contained motor units.

New Technical Books

AN INTRODUCTION TO LABORATORY TECHNIQUE. By A. J. Ansley. Pp. 313. London: Macmillan and Co., Ltd., 12s. 6d.

CONTAINING an up-to-date résumé of the processes and technique required in laboratories, this book is one which should commend itself to a wide field of teachers of science. The references to standard works and recent papers will enable the reader to pursue still further those subjects which he finds of special interest and use. In particular, the book should be of great service to laboratory assistants who have the care of apparatus, and are expected to be skilled in the many tasks which are encountered in demonstration and experimental routine. A selection has been made from the many kinds of work included under laboratory arts, all presented in such a manner that those with little practical training will be able readily to grasp the technique employed. The method of presentation will allow for the preferences of different workers, where the facilities and equipment of laboratories and the skill of workers vary greatly. For example, if we take the production of mirrored surfaces, two methods are available—chemical and electrical. The electrical method can only be carried out by means of expensive equipment, which may be beyond the reach of some institutions and otherwise unessential; in such a case the chemical method can be used with every satisfaction. Since the skill of the technician will also be a variable factor, methods which yield reasonable results with the use of average care and ability have been given. Furthermore, "snags" have been so far as possible removed, or a way of overcoming them has been suggested. Mere bookwork, however, cannot completely fulfil the purpose for which this volume is designed; this can only be realised in its highest degree by patient and constant practice. Many of the processes described are entirely new; some are old and familiar; others are the results of the labours of workers in different fields of science. Although primarily written at the request of those engaged in the teaching of physics, workers in other branches of science will find the book of service, and all who read it should gain a better understanding of laboratory methods and technique.

OUTLINES OF METHODS OF CHEMICAL ANALYSIS. By G. E. F. Lundell and James Irvin Hoffman. Pp. 250. New York: John Wiley and Sons, Inc. London: Chapman and Hall, Ltd. 15s.

In researches on chemical analysis during the past fifty years there has been an ever-increasing tendency to concentrate on the final act of analysis, the determination, at the expense of chemical analysis itself. As a result, there is no lack of excellent methods for the determination of the elements when they occur alone. On the other hand, there has been no corresponding advance in methods of chemical separations or in methods of determination that can be applied to mixtures of the elements. This one-sided development of chemical analysis is perfectly natural, but as more and more elements come into general use, and materials to be analysed grow more and more complex, the narrow viewpoint of a chemical determination becomes more and more precarious and leads to ever-growing difficulties. In this book, therefore, an attempt has been made to feature chemical analyses rather than chemical determinations. The chief aims might be briefly summarised as (1) to furnish analysts with information concerning the behaviour of all the elements in the more important reactions that are used in analytical chemistry; (2) to stimulate searches for more selective reagents; (3) to enlighten chemists who hold chemical analysis in too light regard; and (4) to inform non-chemists concerning the complexities and difficulties that beset the analyst. Detailed descriptions of procedures and extensive references to the literature have been omitted; this has been done in order to keep the treatment as simple and concise as possible.

ORGANIC REAGENTS FOR METALS AND FOR CERTAIN ACID RADICALS. By the Staff of the Research Laboratory of Hopkin and Williams, Ltd. 3rd Edition. Pp. 156. London: Hopkin and Williams, Ltd.

A valuable feature of this book is the up-to-date bibliography which is given for each reagent. It is obvious that no pains have been spared to make these accurate and complete. The methods described show the use of a sound critical faculty in their selection, and the compilers have not hesitated to introduce useful modifications of their own. The paragraphs on interfering metals and their removal or suppression are of great practical value. A further considerable enlargement has been found necessary to keep pace with the growing number of reagents which are available and the extended applications of those already treated in previous editions. Fifteen new monographs have been added, together with some original comparative work on certain azo dyes as colorimetric reagents for magnesium and phenol reagents for nitrate. The title of the book has been extended to cover the inclusion of reagents for acid radicals, viz., alizarin S for fluoride, quinalizarin for borate, and certain reagents for nitrate.

SOLVENTS. By Thos. H. Durrans. 14th Edition. Pp. 238. London: Chapman and Hall, Ltd. 15s.

In the period which has elapsed since the third edition of this book was issued in 1933, considerable advances have been made in the production of solvents and plasticisers and in the elucidation of the scientific principles involved in their use. The necessity for a complete revision and amplification of the book having arisen, the author has also endeavoured to make the book of use to a somewhat wider industrial field without overloading the text by the inclusion of matter of doubtful utility. Particular attention is called to the section dealing with plasticising solvents and toxicity, which have been rewritten; to the enlargement of the appendices, and to the inclusion in an abridged form of the latest specifications issued by the British Standards Institution and by the American Society for Testing Materials.

Ten Years Back

From "The Chemical Age," April 14, 1928

The imports of ammonium sulphate into the United States from Europe during January aggregated 5,448 long tons, of which 4,642 was of German origin. The United Kingdom was credited with 537 tons, Mexico 170, and Belgium 99. There were also imported during January 7,121 tons of ammonium sulphate nitrate, all of German origin.

* * * *

The Cactus Rubber Co., of America, has been incorporated in California for the purpose of manufacturing synthetic rubber from the juice of cactus plants. Dr. John C. Wichmann, of Los Angeles, one of the officers in the new company, has two patents on a perfected process, which he claims will yield 156 lb. of concentrated juice from a ton of cactus material.

* * * *

Reports from Berlin indicate that the I. G. Farbenindustrie has reached an agreement with the Societa Montecatini (of Italy), whereby the latter will obtain the benefit of German experience in the production of synthetic fertiliser materials. It is further stated in a message from Rome that the Societa Montecatini has recently commenced the manufacture of ammonium sulphate-nitrate and calcium nitrate, two I.G. specialities, which would tend to confirm the former report. It is stated that the I.G.-Montecatini negotiations were concluded without any financial acquisition on the part of the Germans in the Italian company.

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Personal Notes

THE LATE MR. JOHN POYNTER, of Sandilands Chemical Works, Aberdeen, left estate valued £132,494.

THE LATE COLONEL FRANCIS ISAAC BENTLEY, D.L., of Ashley, Cheshire, oil refiner, left estate valued £311,012, with net personalty £306,396.

MR. F. W. CHAMBERS, a director of Phœnix Oil Products, Ltd., and Phœnix Oil and Transport Co., has been appointed chairman of those companies in succession to the late Mr. Leopold Alba.

MR. JOHN CHRISTOPHER MANN, general work's manager and also a director of the Midland Tar Distillers, Ltd., of Oldbury, Birmingham, is retiring. Mr. Mann's experience of the tar distilling industry is probably unique. His early career was spent at the Beckton works of the Gas Light and Coke Co., and he was later associated for some time at Hull with Major and Co., Ltd., tar distillers. In April, 1908, he became general work's manager of Robinson Brothers, Ltd., tar distillers and chemical manufacturers, West Bromwich. When the tar distilling interests of this company were merged into the Midland Tar Distillers, Ltd., Mr. Mann took over the position of general work's manager of the latter company, which office he has now resigned. Mr. Mann has sailed for the United States and will attend the annual meeting of the Society of Chemical Industry in Canada in June. He still retains his seat on the board of the Midland Tar Distillers.

LORD MELCHETT, who has been ordered abroad by his doctor, has resigned his directorship of Amalgamated Anthracite Collieries, Ltd.

PROFESSOR B. MOUNT JONES, principal of the Manchester College of Technology, has been appointed Vice-Chancellor of Leeds University.

MR. D. E. UTTLEY, chemical manufacturer, of Littleborough, near Rochdale, Lancashire, has been elected to the Littleborough District Council.

THE LATE MR. CHARLES HENRY KEEN, of Parc, Llanishen, Cardiff, assistant managing director of Guest, Keen, Baldwins Iron and Steel Co., and a director of Guest, Keen and Nettlefolds, left estate valued £128,351, with net personalty £107,092.

MR. T. B. PHILIP was the recipient of presentations on leaving the Kestner Evaporator and Engineering Co., Ltd., to join the staff of the Distillers Co., Ltd. Mr. Philip joined the Kestner Co. some 12 years ago and was chiefly interested in the drying section of their business.

SIR JOSEPH J. THOMSON, O.M., D.Sc., F.R.S., will receive the 1938 Kelvin medal of the Institution of Civil Engineers, in the Great Hall of the Institution, on May 3, at 5 p.m. The presentation will be made by Lord Rayleigh. Mr. S. B. Donkin, president of the Institution of Civil Engineers and chairman of the award committee, will take the chair.

Foreign Chemical Notes

Lithuania

TWO NEW ROOFING FELT FACTORIES are to be erected near Kovno, the market for this material in Lithuania being considered very promising.

Finland

RADIOACTIVE MINERAL WATERS ARE TO BE PRODUCED and sold by the Radium-Hydro O.Y. of Helsingfors, recently formed with a capital of 100,000 Finnish marks.

Belgium

The Lanital Belge S.A. has been registered at Renaix to exploit the Lanital (casein wool) patents in Belgium. Raw material will be imported from Holland at the outset, but will eventually be produced in Belgium itself.

Switzerland

NEW COMPANIES INCLUDE THE FOLLOWING: Frio A.G., Zurich (capital 50,000 francs), production of chemical products for the refrigerating industry; Caristop Co. G.m.b.H., Berne (capital 41,000 francs), production of dental preparations under the brand names of Caristop, Cariwax and Pyo-Stomin; Seresa S.A., Geneva (capital 50,000 francs), chemical and metallurgical products.

Hungary

A NEW FACTORY IN WHICH CELLULOSE WILL BE MADE from beechwood is being erected at Tiszafured by the Nasiczer Co., in association with the Salgotarjan concern.

PHENOLIC RESINS ARE TO BE PRODUCED on a large scale by the Acetic Chemical Works in association with the Salgotarjan Anthracite Mining Co. Experiments on the production of phenol from lignite are understood to have made satisfactory progress so that an adequate supply of this raw material will probably be ensured.

Germany

CONSTRUCTION OF A LIGNITE HYDROGENATION PLANT in the Cologne district has been decided upon by the Union Rheinische Braunkohlen Kraftstoff A.G. of Cologne. About

(*Continued on foot of next column.*)

Society of Dyers and Colourists

Annual Meeting

THE annual meeting of the Manchester section of the Society of Dyers and Colourists was held on April 8, at the rooms of the Manchester Literary and Philosophical Society, Mr. N. Chappell, M.Sc., presiding.

The hon. secretary, Mr. J. G. Evans, presented the sectional report for 1937, in which it was stated that the membership of the section for 1937 was 273 full members, as against 249 for 1936 (an increase of 24), 19 associates, as against 24 (a decrease of 5), 18 junior members, as against 16 (an increase of 2). The total membership for 1937 was 310, as against 289 for 1936, or an increase of 21. During the past year nine general meetings had been held, three of which were held jointly by other societies.

The Knecht memorial prize was awarded to three students, Robert Alan Lonsdale and Harry Smith (Manchester College of Technology), and Gerald B. Stoker (Royal Technical College, Salford).

The average attendance at the meetings had been very high, namely, between 90-100. This average was chiefly due to the very good attendances at the lectures delivered by Mr. A. J. Hall (March 19, "A new non-chlorine unshrinkable finish on wool"), Dr. Wilhelm Christ (October 15, "Indigosols, leuco esters of vat dyestuffs"), and Mr. F. W. Mackenzie (November 19, "Screen printing"), when between 130-150 members were present on each occasion.

Messrs. Adams, Blakeley, R. J. Hannay, Heap, Holden, McMyn and Williams were re-elected members of the committee.

(*Continued from preceding column.*)

800 to 1,000 workers will be employed when the plant is in production.

A NEW COAL-OIL PLANT recently started up at the works of the Ruhröl G.m.b.H. utilises a 2-stage process. In the first, an extract of the coal is prepared by the Pott-Broche process and in the second stage this extract is hydrogenated by the high pressure process of the I.G. Farbenindustrie. The extract can be replaced, however, by hard and soft pitch and pitch distillates otherwise not easily amenable to fuel production.

From Week to Week

The Chemical Age Lawn Tennis Tournament

Entries Close May 3.

Entries for THE CHEMICAL AGE Lawn Tennis Tournament, details of which were published on April 2, must be sent in by May 3 (first post). The tournament, for which there is no entrance fee, comprises men's singles and doubles, open to members of the chemical industry throughout Great Britain, either as principals or members of staffs. THE CHEMICAL AGE silver challenge cups are held by the winners for twelve months, and statuettes are presented outright to the winners and runners-up.

Immediate application should be made for full particulars and entry forms to The Editor, THE CHEMICAL AGE, Bouverie House, 154 Fleet Street, London, E.C.4. (Telephone: Central 3212).

THE REGISTERED AND TRANSFER OFFICES of British Emulsifiers are now at Bel Works, Hampton Road, Hanworth, Middlesex. Telephone: Feltham 3033.

FRENCH IMPORTS OF COAL and other raw materials declined heavily during March, 1938. Exports of chemicals and minerals and metals were higher than during March, 1937.

THE IRON AND STEEL INSTITUTE has taken over 4 Grosvenor Gardens, London, which was recently occupied by the American Embassy, and will move to its new premises in June.

COLCHESTER TOWN COUNCIL are to install chloramine equipment for use in connection with the chlorinating plant and an ammoniator is to be purchased from Wallace and Tierman, Ltd., at a cost of about £137.

A BUSINESS MAN'S GUIDE to Denmark has just been published by the Danish-British Association, Copenhagen. It is extremely comprehensive and is particularly interesting as showing the position which Denmark holds among customers of this country.

THE WEST CUMBERLAND PUBLICITY COMMITTEE has published a folder relating to the advantages which the Special Area of West Cumberland offers to industrialists. Great efforts are being made at the present moment to restore to this area some measure of the prosperity which it once enjoyed.

BARRETT, TAGANT AND GOTTS, LTD., manufacturers of and dealers in oils, fats, greases, waxes, soaps, etc., Corrisson Works, Wandsworth Bridge, Fulham, S.W.6, have increased their nominal capital by the addition of £15,000 in £1 ordinary shares beyond the registered capital of £25,000. Part of the above increase is for the purpose of acquiring the issued share capital of Frank How & Co., Ltd.

THREE WORKMEN AND A FIRE BRIGADE OFFICER were injured in a fire which occurred at Eskmill Paper Mills, Penicuik, near Edinburgh, on April 7. The fire occurred in a shed which contained 2,000 tons of wood pulp. The workmen were using a hose when a wooden wall fell about them. Officer W. Sutherland Brodie, who was in charge of a detachment of Edinburgh Fire Brigade, was injured in going to their assistance.

THE BRITISH IRON AND STEEL FEDERATION announce that pig iron production in March amounted to 714,600 tons, against 680,300 tons in March last year, and that the output of steel ingots and castings was 1,115,800 tons, against 1,109,500 tons. There were 118 furnaces in blast at the end of March, compared with 124 furnaces at the end of February, eight furnaces having ceased operations during the month, and two having resumed production.

THE SOCIAL ORGANISATION run by the employees of the United Steel Companies' Cumberland Group (Workington Iron and Steel Co., Beckermet and Bigrigg Hematite Mines, Rowrah Quarries, etc.) have decided to proceed with a £6,500 welfare hall, to be erected in Workington. Half of the cost of the hall will be donated by the United Steel Companies, Ltd., and the remaining half is to be handed over to the organisation as a loan, to be paid off by them over a term of years.

THE LIVERPOOL SECTION of the British Association of Chemists held their annual meeting in the Exchange Hotel, Liverpool, on April 6, when the chairman, Mr. W. S. Reid, presided. The report of the committee showed that the membership totalled 200, which included 168 full members, 28 probationary members, 2 student members, and 2 honorary student members. The following officers were elected for the 1938-39 session: Chairman, Mr. A. Betton; vice-chairman, Mr. D. T. Bruce; hon. treasurer, Dr. F. W. Kay; hon. secretary, Mr. E. Myer; committee, D. G. Barkla, V. Biske, G. C. Corbett, T. E. Fore, E. P. McManus, W. McNamee, H. P. Minton, G. C. Riley, W. S. Reid, M. Rosebery, J. Sowler, L. Wild, and C. A. Wylie.

THE REGISTERED OFFICE of International Diatomite is now at 103 Kingsway, W.C.2.

WHILE REPAIRING electric plant at the Northern Aluminium Works, Banbury, Oxfordshire, on April 7, Walter Lines (40), of Swallcliffe, was electrocuted.

AN EXPLOSION IN AN OVEN at the metal works of Swanser and Sons, Finsbury Park, on Tuesday, resulted in the death of W. Steinel, a maintenance man.

GOODLASS WALL AND LEAD INDUSTRIES announces that on and after April 19 the registered and transfer offices will be at Ibex House, Minories, E.C.3. Telephone unchanged.

MOST OF THE SUGAR WORKERS who came out on strike at Port of Spain, Trinidad, on April 4 for higher wages, have returned to work voluntarily without any wage increases.

BRITISH OUTPUT OF DYESTUFFS IN 1937 reached the record total of 63,265,331 lb., against the previous record figures of 61,222,901 lb. in 1936 and 58,713,384 lb. in 1935. Production has risen from 23,832,967 lb. in 1922.

THE EXPORT QUOTA OF SULPHITE PULP for 1938 is to be reduced by 20 per cent. This is the result of a decision arrived at by Sulphite Pulp Suppliers, the organisation of European exporters of sulphite pulp. The reduction is to become effective at once.

THE MANAGEMENT APPOINTMENTS BOARD of the Confederation of Management Associations has just issued a prospectus which is unique as an experiment in centralising the appointments work for executive posts in industry and certain branches of engineering.

UNITED STATES zinc production in March was 43,400 tons, compared with 41,100 tons in February. Deliveries totalled 33,500 tons, against 21,500 tons, while stocks at the end of March aggregated 118,000 tons, compared with 108,100 tons at the end of February.

IT IS UNDERSTOOD that the House of Commons decision will not affect the plans of the British Oxygen Co., Ltd., to erect a carbide factory in South Wales. The company has acquired the site, building plans are well in hand, and it is hoped to reach production stage in about eighteen months' time.

FIVE MEN WERE BURNED, three severely, when flames from blazing pitch shot 10 yards across a shed at soapworks in Morley, near Leeds, on April 6. The men were engaged in the paint department of Wilkinson's Soap Works and were enveloped in flames as the pitch, boiling in a huge pan, took fire.

FIFTEEN HUNDRED MEN, members of the Amalgamated Engineering Union and Boilermakers' Society, came out on strike at the works of Imperial Chemical Industries at Billingham-on-Tees, on April 7, because they alleged that the company had employed a non-trades union foreman in the fitting department. The strike is unofficial, and I.C.I., in an official statement, holds that it is a breach of the agreement.

THE MINISTER OF TRANSPORT has received a deputation on the subject of the development of the use of producer gas, generated from British coal, as an alternative to imported liquid fuel for road transport. The deputation consisted of representatives of the coke, anthracite, transport, and manufacturing interests, including the Coal Utilisation Council and the Low Temperature Coal Distillers' Association.

OIL-BORING ON A LARGE SCALE is to be undertaken shortly in New Zealand, according to an announcement by the Minister of Mines (Mr. Webb). Seventy-eight applications from six groups for prospecting rights have been received. Four prospecting licences covering ten areas of approximately eight hundred square miles in the Gisborne district are being issued to the New Zealand Petroleum Co., which includes the Vacuum Oil Co. (Proprietary), Ltd.

THE PORTSMOUTH CHEMICAL SOCIETY now has a membership of 58. At the first annual meeting the chairman, F. G. Edmed, F.I.C., gave a brief survey of the history of industrial chemistry to its present vital position. The following were elected officers: Chairman, F. G. Edmed, F.I.C.; vice-chairmen, F. Beddow, J.P., D.Sc., W. H. Watson, M.Sc., R. P. Page, F.I.C., C. G. Lyons, B. A., Ph.D.; hon. secretary, E. N. Dodd, Ph.D., A.I.C.; committee, H. G. Dane, M.Sc., A.I.C., F. Hemming, A. Hall.

UNLESS FUNDS CAN BE OBTAINED, the National Institute of Industrial Psychology must close at the end of next month, after 17 years' study of the "human factor" in factory, office and school. According to the director of the Institute, at least £2,000 is needed immediately to save the Institute. Its work cannot continue effectively unless an income of £6,000 a year is assured, in addition to the fees charged for services. The Ministries of Education, Labour and Health are being approached in the hope that the nation will contribute something towards the cost of work which has been recognised as of national importance.

Weekly Prices of British Chemical Products

MOVEMENTS in the general chemical market during the past week have been on a very moderate scale and conditions in most sections are reported quiet for the period. At the consuming end, however, buyers appear to be taking up their commitments under existing contracts with a fair degree of promptness. There is no important change in values to record for general chemicals, rubber chemicals and wood distillation products and quotations for nearly all items are on a steady basis. The promise of an early improvement in the coal tar section has not yet materialised and conditions in the market during the past week have been distinctly quiet, and in absence of firm buying orders prices remain nominal.

MANCHESTER.—Trading in heavy chemicals on the Manchester market during the past week has continued on very moderate lines and not much improvement is looked for during the remainder of this month. Contract deliveries will be seriously interfered with owing to the holidays, but apart from this seasonal influence the movement into consumption is said to be reasonably satisfactory. Values generally remain on a steady to firm basis. The tar products market keeps rather dull and no more than a quiet business has been put through. Some expansion, however, is anticipated after the holidays. Quotations for the by-products have further eased here and there, though taking the market as a whole weakness has been less in evidence, and it is hoped that the full extent of the decline has been about reached.

Price Changes

Rises: Pitch (Manchester).

Falls: Copper Sulphate (Manchester); Potash Caustic (Manchester); Pyridine (Manchester).

General Chemicals

ACETONE.—**£45 to £47 per ton.**

ACETIC ACID.—Tech, 80%, £30 5s. per ton; pure 80%, £32 5s.; tech., 40%, £15 12s. 6d. to £18 12s. 6d.; tech., 60%, £23 10s. to £25 10s. MANCHESTER: 80%, commercial, £30 5s.; tech. glacial, £42 to £46.

ALUM.—Loose lump, £8 7s. 6d. per ton d/d; GLASGOW: Ground, £10 7s. 6d. per ton; lump, £9 17s. 6d.

ALUMINIUM SULPHATE.—£7 2s. 6d. per ton d/d Lancs. GLASGOW: £7 to £8 ex store.

AMMONIA, ANHYDROUS.—Spot, 1s. to 1s. 1d. per lb. d/d in cylinders. SCOTLAND: 10½d. to 1s. 0½d., containers extra and returnable.

AMMONIA, LIQUID.—SCOTLAND: 80°, 2½d. to 3d. per lb., d/d.

AMMONIUM CARBONATE.—£20 per ton d/d in 5 cwt. casks.

AMMONIUM CHLORIDE.—Grey galvanising, £19 per ton, ex wharf.

AMMONIUM CHLORIDE (MURIATE).—SCOTLAND: British dog tooth crystals, £32 to £35 per ton carriage paid according to quantity. (See also Salammoniac.)

AMMONIUM DICHROMATE.—8¼d. per lb. d/d U.K.

ANTIMONY OXIDE.—£68 per ton.

ARSENIC.—Continental material £11 per ton c.i.f., U.K. ports; Cornish White, £12 5s. to £12 10s. per ton f.o.r., mines, according to quantity. MANCHESTER: White powdered Cornish, £16 10s. per ton, ex store.

BARIUM CHLORIDE.—£11 10s. to £12 10s. per ton in casks ex store. GLASGOW: £11 10s. per ton.

BLEACHING POWDER.—Spot, 35/37%, £9 5s. per ton in casks, special terms for contracts. SCOTLAND: £9 per ton net ex store.

BORAX COMMERCIAL.—Granulated, £16 per ton; crystal, £17; powdered, £17 10s.; extra finely powdered, £18 10s., packed in 1-cwt. bags, carriage paid home to buyers' premises within the United Kingdom in 1-ton lots. GLASGOW: Granulated, £16, crystal, £17; powdered, £17 10s. per ton in 1-cwt. bags, carriage paid.

BORIC ACID.—Commercial granulated, £28 10s. per ton; crystal, £29 10s.; powdered, £30 10s.; extra finely powdered, £32 10s. in 1-cwt. bags, carriage paid home to buyers' premises within the United Kingdom in 1-ton lots. GLASGOW: Crystals, £29 10s.; powdered, £30 10s. 1-cwt. bags in 1-ton lots.

CALCIUM BISULPHITE.—£6 10s. per ton f.o.r. London.

CHARCOAL, LUMP.—£6 to £6 10s. per ton, ex wharf. Granulated, £7 to £9 per ton according to grade and locality.

CHROMETAN.—Crystals, 2¼d. per lb.; liquor, £19 10s. per ton d/d. station in drums. GLASGOW: 70/75% solid, £5 15s. per ton net ex store.

CHROMIC ACID.—9¾d. per lb., less 2½%; d/d U.K.

CHROMIUM OXIDE.—11d. per lb.; d/d U.K.

CITRIC ACID.—1s. 0¼d. per lb. MANCHESTER: 1s. 0½d. SCOTLAND: B.P. crystals, 1s. 0½d. per lb.; less 5%, ex store.

COPPER SULPHATE.—£21 7s. 6d. per ton, less 2% in casks. MANCHESTER: £18 10s. per ton f.o.b. SCOTLAND: £19 10s. per ton, less 5%, Liverpool, in casks.

CREAM OF TARTAR.—100%, 92s. per cwt., less 2½%. GLASGOW: 99%, £4 12s. per cwt. in 5-cwt. casks.

FORMALDEHYDE.—£20-£22 per ton.

FORMIC ACID.—85%, in carboys, ton lots, £42 to £47 per ton.

GLYCERINE.—Chemically pure, double distilled, 1.260 s.g., in tins, £4 12s. 6d. to £5 12s. 6d per cwt. according to quantity; in drums, £4 5s. 0d. to £4 17s. 6d.

HYDROCHLORIC ACID.—Spot, 5s. 6d. to 8s. carboy d/d according to purity, strength and locality.

IODINE.—Resublimed B.P., 6s. 4d. per lb. in 7 lb. lots.

LACTIC ACID.—(Not less than ton lots). Dark tech., 50% by vol., £24 10s. per ton; 50% by weight, £28 10s.; 80% by weight, £50; pale tech., 50% by vol., £28; 50% by weight, £33; 80% by weight, £55; edible, 50%, by vol., £41. One-ton lots ex works, barrels free.

LEAD ACETATE.—LONDON: White, £31 10s. ton lots; brown, £35. GLASGOW: White crystals, £32; brown, £1 per ton less. MANCHESTER: White, £32; brown, £31.

LEAD, NITRATE.—£32 per ton for 1-ton lots.

LEAD, RED.—£32 15s. 0d. 10 cwt. to 1 ton, less 2½% carriage paid. SCOTLAND: £32 per ton, less 2¼% carriage paid for 2-ton lots.

LITHARGE.—SCOTLAND: Ground, £32 per ton, less 2½%, carriage paid for 2-ton lots.

MAGNESITE.—SCOTLAND: Ground calcined, £9 per ton, ex store.

MAGNESIUM CHLORIDE.—SCOTLAND: £7 10s. per ton.

MAGNESIUM SULPHATE.—Commercial, £5 10s. per ton, ex wharf.

MERCURY.—Ammoniated B.P. (white precip.), lump, 5s. 10d. per lb.; powder B.P., 6s. 0d.; bichloride B.P. (corros. sub.) 5s. 1d.; powder B.P. 4s. 9d.; chloride B.P. (calomel), 5s. 10d.; red oxide cryst. (red precip.), 6s. 11d.; levig. 6s. 5d.; yellow oxide B.P. 6s. 3d.; persulphate white B.P.C., 6s. 0d.; sulphide black (hyd. sulph. cum sulph. 50%), 5s. 11d. For quantities under 112 lb., 1d. extra; under 28 lb., 5d. extra.

METHYLATED SPIRIT.—61 O.P. industrial, 1s. 5d. to 2s. per gal.; pyridinised industrial, 1s. 7d. to 2s. 2d.; mineralised, 2s. 6d. to 3s. Spirit 64 O.P. is 1d. more in all cases and the range of prices is according to quantities. SCOTLAND: Industrial 64 O.P., 1s. 9d. to 2s. 4d.

NITRIC ACID.—Spot, £25 to £30 per ton according to strength, quantity and destination.

OXALIC ACID.—£48 15s. to £57 10s. per ton, according to packages and position. GLASGOW: £2 9s. per cwt. in casks. MANCHESTER: £49 to £54 per ton ex store.

PARAFFIN WAX.—SCOTLAND: 3¾d. per lb.

POTASH CAUSTIC.—Solid, £35 5s to £40 per ton according to quantity, ex store; broken, £42 per ton. MANCHESTER: £38 10s.

POTASSIUM CHLORATE.—£36 7s. 6d. per ton. GLASGOW: 4½d. per lb. MANCHESTER: £37 10s. per ton.

POTASSIUM DICHROMATE.—5½d. per lb. carriage paid. SCOTLAND: 5¼d. per lb., net, carriage paid.

POTASSIUM IODIDE.—B.P. 5s. 6d per lb. in 7 lb. lots.

POTASSIUM NITRATE.—Small granular crystals, £24 to £27 per ton ex store, according to quantity. GLASGOW: Refined granulated, £29 per ton c.i.f. U.K. ports. Spot, £30 per ton ex store.

POTASSIUM PERMANGANATE.—LONDON: 9¾d. per lb. SCOTLAND: B.P. Crystals, 9¾d. MANCHESTER: B.P. 10½d. to 1s.

POTASSIUM PRUSSIATE.—6½d. per lb. SCOTLAND: 7d. net, in casks, ex store. MANCHESTER: Yellow, 6½d.

SALAMMONIAC.—Firsts lump, spot, £42 17s. 6d. per ton, d/d address in barrels. Dog-tooth crystals, £36 per ton; fine white crystals, £18 per ton, in casks, ex store. GLASGOW: Large crystals, in casks, £37 10s.

SALT CAKE.—Unground, spot, £3 11s. per ton.

SODA ASH.—58% spot, £5 17s. 6d. per ton f.o.r. in bags.

SODA, CAUSTIC.—Solid, 76/77° spot, 13s. 10s. per ton d/d station. SCOTLAND: Powdered 98/99%, £18 10s. in drums, £19 5s. in casks, Solid 76/77° £15 12s. 6d. in drums; 70/73%, £15 12s. 6d., carriage paid buyer's station, minimum 4-ton lots; contracts, 10s. per ton less.

SODA CRYSTALS.—Spot, £5 to £5 5s. per ton d/d station or ex depot in 2-cwt. bags.

SODIUM ACETATE.—£19-£20 per ton carriage paid North. GLASGOW: £18 10s. per ton net ex store.

SODIUM BICARBONATE.—Refined spot, £10 15s. per ton d/d station in bags. GLASGOW: £13 5s. per ton in 1 cwt. kegs, £11 5s. per ton in 2-cwt. bags. MANCHESTER: £10 10s.

SODIUM BISULPHITE POWDER.—60/62%, £20 per ton d/d 1 cwt. iron drums for home trade.

SODIUM CARBONATE MONOHYDRATE.—£20 per ton d/d in minimum ton lots in 2 cwt. free bags.

SODIUM CHLORATE.—£27 10s. to £32 per ton. GLASGOW: £1 11s. per cwt., minimum 3 cwt. lots.

SODIUM DICHROMATE.—Crystals cake and powder 4½d. per lb. net d/d U.K. with rebates for contracts. MANCHESTER:

SODIUM CHROMATE.—4½d. per lb. d/d U.K.

4d. per lb. GLASGOW: 4½d. net, carriage paid.

SODIUM HYPOSULPHITE.—Pea crystals, £15 5s. per ton for 2-ton lots; commercial, £11 5s. per ton. MANCHESTER: Commercial, £11; photographic, £15 10s.

SODIUM METASILICATE.—£14 5s. per ton, d/d U.K. in cwt. bags.

SODIUM NITRATE.—Refined, £8 per ton for 6-ton lots d/d. GLASGOW: £1 12s. 0d. per cwt. in 1-cwt. kegs, net, ex store.

SODIUM NITRITE.—£18 5s. per ton for ton lots.

SODIUM PERBORATE.—10%, 9½d. per lb. d/d in 1-cwt. drums.

SODIUM PHOSPHATE.—Di-sodium, £12 per ton delivered for ton lots. Tri-sodium, £15 to £16 per ton delivered per ton lots.

SODIUM PRUSSIATE.—½d. per lb. for ton lots. GLASGOW: 5d. to 5¾d. ex store. MANCHESTER: 4¼d. to 5¼d.

SODIUM SILICATE.—£8 2s. 6d. per ton.

SODIUM SULPHATE (GLAUBER SALTS).—£3 per ton d/d.

SODIUM SULPHATE (SALT CAKE).—Unground spot, £3 to £3 10s. per ton d/d station in bulk. SCOTLAND: Ground quality, £3 5s. per ton d/d. MANCHESTER: £3 12s. 6d.

SODIUM SULPHIDE.—Solid 60/62%, Spot, £11 15s. per ton d/d in drums; crystals, 30/32%, £9 per ton d/d in casks. MANCHESTER: Concentrated solid, 60/62%, £11; commercial, £8 10s.

SODIUM SULPHITE.—Pea crystals, spot, £14 10s. per ton d/d station in kegs.

SULPHUR PRECIP.—B.P., £55 to £60 per ton according to quantity. Commercial, £50 to £55.

SULPHURIC ACID.—168° Tw., £4 11s. to £5 1s. per ton; 140° Tw., arsenic-free, £3 to £3 10s.; 140° Tw., arsenious, £2 10s.

TARTARIC ACID.—1s. 1¼d. per lb. less 5%, carriage paid for lots of 5 cwt. and upwards. MANCHESTER: 1s. 1¼d. per lb. GLASGOW: 1s. 1d. per lb., 5%, ex store.

ZINC SULPHATE.—Tech., £11 10s. f.o.r., in 2 cwt. bags.

Rubber Chemicals

ANTIMONY SULPHIDE.—Golden, 7d. to 1s. 2d. per lb., according to quality. Crimson, 1s. 6d. to 1s. 7½d. per lb.

ARSENIC SULPHIDE.—Yellow, 1s. 5d. to 1s. 7d. per lb.

BARYTES.—£6 to £6 10s. per ton, according to quality.

CADMIUM SULPHIDE.—6s. to 6s. 3d. per lb.

CARBON BLACK.—4d. per lb., ex store.

CARBON DISULPHIDE.—£31 to £33 per ton, according to quantity, drums extra.

CARBON TETRACHLORIDE.—£41 to £46 per ton, according to quantity, drums extra.

CHROMIUM OXIDE.—Green, 10½d. to 11d. per lb.

DIPHENYLGUANIDINE.—2s. 2d. per lb.

INDIA-RUBBER SUBSTITUTES.—White, 4¾d. to 5½d. per lb.; dark 4d. to 4½d. per lb.

LAMP BLACK.—£24 to £26 per ton del., according to quantity. Vegetable black, £35 per ton upwards.

LEAD HYPOSULPHITE.—9d. per lb.

LITHOPONE.—Spot, 30%, £16 10s. per ton, 2-ton lots d/d in bags.

SULPHUR.—£9 to £9 5s. per ton. SULPHUR PRECIP. B.P., £55 to £60 per ton. SULPHUR PRECIP. COMM., £50 to £55 per ton.

SULPHUR CHLORIDE.—5d. to 7d. per lb., according to quantity.

VERMILION.—Pale, or deep, 5s. per lb., 1-cwt. lots.

ZINC SULPHIDE.—£58 to £60 per ton in casks ex store, smaller quantities up to 1s. per lb.

Nitrogen Fertilisers

AMMONIUM SULPHATE.—The following prices have been announced for neutral quality basis 20.6% nitrogen, in 6-ton lots delivered farmer's nearest station up to June 30, 1938: November, £7 8s.; December, £7 9s. 6d.; January, 1938, £7 11s.; February, £7 12s. 6d.; March/June, £7 14s.

CALCIUM CYANAMIDE.—The following prices are for delivery in 5-ton lots, carriage paid to any railway station in Great Britain up to June 30, 1938: November, £7 10s.; December, £7 11s. 3d.; January, 1938, £7 12s. 6d.; February, £7 13s. 9d.; March, £7 15s.; April/June, £7 16s. 3d.

NITRO CHALK.—£7 10s. 6d. per ton up to June 30, 1938.

SODIUM NITRATE.—£8 per ton for delivery up to June 30, 1938.

CONCENTRATED COMPLETE FERTILISERS.—£11 4s. to £11 13s. per ton in 6-ton lots to farmer's nearest station.

AMMONIUM PHOSPHATE FERTILISERS.—£10 19s. 6d. to £14 16s. 6d. per ton in 6-ton lots to farmer's nearest station.

Coal Tar Products

BENZOL.—At works, crude, 9¼d. to 9¾d. per gal.; standard motor, 1s. 2¾d. to 1s. 3¼d.; 90%, 1s. 3¾d. to 1s. 4¼d.; pure, 1s. 7¾d. to 1s. 8¼d. GLASGOW: Crude, 10d. to 10½d. per gal.; motor, 1s. 4d. to 1s. 4½d.

CARBOLIC ACID.—Crystals, 7¾d. to 8¼d. per lb., small quantities would be dearer; Crude, 60's, 3s. 6d. to 3s. 9d.; dehydrated, 4s. 4½d. to 4s. 7½d. per gal. MANCHESTER: Crystals, 7½d. per lb. f.o.b. in drums; crude, 3s. to 3s. 6d. per gal.

CREOSOTE.—Home trade, 5½d. per gal., f.o.r. makers' works; exports, 6⅜d. to 6⅝d. per gal., according to grade MANCHESTER: 4½d. to 5½d. GLASGOW: B.S.I. Specification, 6d. to 6½d. per gal.; washed oil, 5d. to 5½d.; lower sp. gr. oils, 5¾d. to 6½d.

CRESYLIC ACID.—97/99%, 2s. 5d. to 2s. 8d.; 99/100%, 4s. to 5s. 6d. per gal., according to specification; Pale, 99/100%, 2s. 9d. to 3s.; Dark, 95%, 2s. 4d. to 2s. 5½d. per gal. GLASGOW: Pale, 99/100%, 5s. to 5s. 6d. per gal.; pale, 97/99%, 4s. 6d. to 4s. 10d., dark, 97/99%, 4s. 3d. to 4s. 6d.; high boiling acids, 2s. to 2s. 6d. American specification, 3s. 9d. to 4s. MANCHESTER: Pale, 99/100%, 3s.

NAPHTHA.—Solvent, 90/160, 1s. 6d. to 1s. 7d. per gal.; solvent, 95/160%, 1s. 7d. to 1s. 8d., naked at works; heavy 90/190%, 1s. 1½d. to 1s. 3d. per gal., naked at works, according to quantity. GLASGOW: Crude, 6½d. to 7½d. per gal.; 90%, 160, 1s. 5d. to 1s. 6d., 90%, 190, 1s. 1d. to 1s. 3d.

NAPHTHALENE.—Crude, whizzed or hot pressed, £5 5s. to £6 5s. per ton; purified crystals, £14 per ton in 2-cwt. bags. LONDON: Fire lighter quality, £5 10s. to £7 per ton. GLASGOW: Fire lighter, crude, £6 to £7 per ton (bags free). MANCHESTER: Refined, £15 10s. per ton f.o.b.

PITCH.—Medium, soft, 35s. per ton, f.o.b. MANCHESTER: 32s. 6d. f.o.b., East Coast. GLASGOW: f.o.b. Glasgow, 35s. to 37s. per ton; in bulk for home trade, 35s.

PYRIDINE.—90/140%, 13s. 6d. to 15s. per gal.; 90/160%, 10s. 6d. to 13s. 3d. per gal.; 90/180%, 3s. 3d. to 4s. per gal. f.o.b. GLASGOW: 90% 140, 10s. to 12s. per gal.; 90% 160, 9s. to 10s.; 90% 180, 2s. 6d. to 3s. MANCHESTER: 11s. to 12s. per gal.

TOLUOL.—90%, 1s. 10d. per gal.; pure, 2s. 2d. GLASGOW: 90%, 120, 1s. 10d. to 2s. 1d. per gal.

XYLOL.—Commercial, 1s. 11d. to 2s. per gal.; pure, 2s. 3d. to 2s. 3½d. GLASGOW: Commercial, 2s. to 2s. 1d. per gal.

Wood Distillation Products

CALCIUM ACETATE.—Brown, £7 10s. to £8 per ton; grey, £9 10s. to £10. MANCHESTER: Brown, £9 10s.; grey, £11 10s.

METHYL ACETONE.—40.50%, £35 to £40 per ton.

WOOD CREOSOTE.—Unrefined, 4d. to 6d. per gal., according to boiling range.

WOOD NAPHTHA, MISCIBLE.—3s. 3d. to 3s. 6d. per gal.; solvent, 3s. 6d. to 3s. 9d. per gal.

WOOD TAR.—£2 to £8 per ton, according to quality.

Intermediates and Dyes

ANILINE OIL.—Spot, 8d. per lb., drums extra, d/d buyer's works.

ANILINE SALTS.—Spot, 8d. per lb. d/d buyer's works, casks free.

BENZIDINE, HCl.—2s. 7½d. per lb., 100% as base, in casks.

BENZOIC ACID, 1914 B.P. (ex toluol).—1s. 11d. per lb. d/d buyer's works.

m-CRESOL 98/100%.—1s. 8d. to 1s. 9d. per lb. in ton lots.

o-CRESOL 30/31° C.—6½d. to 7½d. per lb. in 1-ton lots.

p-CRESOL, 34-5° C.—1s. 7d. to 1s. 8d. per lb. in ton lots.

DICHLORANILINE.—2s. 1½d. to 2s. 5½d. per lb.

DIMETHYLANILINE.—Spot, 1s. 7½d. per lb., package extra.

DINITROBENZENE.—8¼d. per lb.

DINITROCHLORBENZENE, SOLID.—£79 5s. per ton.

DINITROTOLUENE.—48/50° C., 9¼d. per lb.; 66/68° C., 11d.

DIPHENYLAMINE.—Spot, 2s. 2d. per lb., d/d buyer's works.

GAMMA ACID, Spot, 4s. 4½d. per lb. 100% d/d buyer's works.

H ACID.—Spot, 2s. 7d. per lb.; 100% d/d buyer's works.

NAPHTHIONIC ACID.—1s. 10d. per lb.

β-NAPHTHOL.—£97 per ton; flake, £94 8s. per ton.

a-NAPHTHYLAMINE.—Lumps, 1s. 1d. per lb.

β-NAPHTHYLAMINE.—Spot, 3s. per lb.; d/d buyer's works.

NEVILLE AND WINTHER'S ACID.—Spot, 3s. 3½d. per lb. 100%.

o-NITRANILINE.—4s. 3½d. per lb.

m-NITRANILINE.—Spot, 2s. 10d. per lb. d/d buyer's works.

p-NITRANILINE.—Spot, 1s. 10d. to 2s. 3½d. per lb. d/d buyer's works.

NITROBENZENE.—Spot, 4½d. to 5d. per lb., in 90-gal. drums, drums extra. 1-ton lots d/d buyer's works.

NITRONAPHTHALENE.—10½d. per lb.; P.G., 1s. 0½d. per lb.

SODIUM NAPHTHIONATE.—Spot, 1s. 11d. per lb.; 100% d/d buyer's works.

SULPHANILIC ACID.—Spot, 8¾d. per lb. 100%, d/d buyer's works.

o-TOLUIDINE.—11½d. per lb., in 8/10-cwt. drums, drums extra.

p-TOLUIDINE.—2s. per lb., in casks.

m-XYLIDINE ACETATE.—4s. 8d. per lb., 100%.

Company News

Goodlass Wall and Lead Industries, Ltd., is to maintain its dividend at 6 per cent. and bonus at 1 per cent., less tax, for 1937.

Babcock and Wilcox, Ltd., have declared a final dividend of 6 per cent., less tax, making 16 per cent. for the year, the same as in 1936.

Lewis Berger and Sons have announced an interim on the ordinary shares in respect of year ending July 31, 1938, of 6 per cent. actual, less tax (same), payable May 2.

Stewarts and Lloyds, Ltd., announce an increase of 5 per cent. in its dividend for 1937. The payment on the Deferred stock is to be 12½ per cent. (7½ per cent.), the biggest dividend since 1924.

Olympic Portland Cement, Ltd., announce a net profit for 1937, £27,729 (£39,995); less depreciation written off property, £14,727 (same); final of 5 per cent., making 7½ per cent. (same); forward, £28,026 (£31,626).

Society of Chemical Industry in Basle (Ciba), reports that after deducting 3,200,000f. for depreciation and 1,000,000f. as extraordinary transfer for workers' pension fund, net profit is 5,183,000f. (4,610,000f.). A dividend of 20 per cent. (same) is announced.

Sternol, Ltd., manufacturers and retailers of petroleum products, in their accounts for 1937, show net profit £10,327 (£3,387). To reserve for tax and N.D.C. £1,169 (£600); dividend of 4 per cent., less tax, was paid on August 14, and further 4 per cent. on November 4, in respect of arrears to June, 1933, on 8 per cent. cumulative participating preferred ordinary; forward, £4,390 (£4,232).

Bryant and May, Ltd., have announced the following dividends: On the preference shares at the rate of 14 per cent. per annum for the half-year ended March 31, 1938; final on the partnership shares 5 per cent., free of tax; final on the ordinary shares 15 per cent., free of tax, making 25 per cent. for the year. These dividends are the same as last year. Employees' proportion of profits, under the articles, is £42,626.

North British Rubber Co., show a further rise in trading profits for 1937 from £91,656 to £113,057. Depreciation absorbs £31,417 compared with £31,792, and after deducting debenture interest and directors' fees, net profits amount to £61,139—an increase of £21,746. During the year the company brought dividends on the £100,000 5 per cent. cumulative first preference shares up to date, and on March 1, a further three years' arrears of dividend to June 30, 1933, on the £125,000 5 per cent. cumulative second preference shares has been paid. This leaves the carry-forward doubled at £44,799, against £22,409.

Forthcoming Events

London.

April 27.—Electrodepositors' Technical Society. Northampton Polytechnic Institute, St. John Street, Clerkenwell, E.C.1. 8.15 p.m. A. W. Hothersall and C. J. Leadbetter, "Electrodeposition on Tin-Plate."

The Institution of Chemical Engineers. Joint Meeting with Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2. 6 p.m. Dr. H. J. T. Ellingham, "Electrolysis: Principles of Plant Design and Operation."

April 28.—The Chemical Society. Burlington House, Piccadilly, W.1. 8 p.m. Ordinary Scientific Meeting.

Institute of Fuel. Junior Institution of Engineers, 39 Victoria Street, S.W.1. 6 p.m. Robert R. Harman, "Removal of Suspended Matter from Industrial Gases."

Newcastle.

April 22.—The Chemical Society. University Union. 7.30 p.m. Annual N.E. Coast Chemical and Allied Industries Dinner.

April 28.—Coke Oven Managers' Association. Professor H. L. Riley, "The Carbonisation Process."

Chemical Trade Inquiries

The following trade inquiries are abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

British West Indies.—A well-established firm of agents at Granada wishes to obtain the representation of United Kingdom manufacturers of soya bean oil. (Ref. No. 248.)

Canada.—A well-established firm of agents at Montreal wishes to obtain the representation, on a purchasing basis, of United Kingdom manufacturers of china clay and alum for Eastern Canada. (Ref. No. 250.)

Egypt.—A firm in Cairo wishes to obtain the representation of United Kingdom manufacturers of pharmaceutical products. (Ref. No. 256.)

New Companies Registered

Micron Laboratories, Ltd. 338,970.—Private company. Capital, £4,000 in 4,000 shares of £1 each. To carry on the business of manufacturers of and dealers in medicines, remedies, specifics, secret processes, foods, pharmaceutical and other products, etc. Directors: Nathaniel Martin, 158 Great Portland Street, W.1; Leon Shine, F.B.A.A. Registered office: St. Georges House, 16 Wells Street, W.1.

Chemical and Allied Stocks and Shares

HOPES that the Budget may not bring a heavy increase in direct taxation continued to influence sentiment in the industrial and kindred sections of the Stock Exchange. The volume of business was on the small side owing to holiday influences, but general market conditions were reported to be firmer than for some time past, and in the absence of selling pressure, most actively-dealt-in industrial securities have moved in favour of holders, although best prices touched this week were not always maintained.

Shares of companies identified with the chemical and associated trades reflected the firmer market conditions, and numerous movements in favour of holders have been shown. So far the better trend of markets has not progressed sufficiently for interest to broaden to smaller-priced shares, and gains, therefore, have been mainly confined to shares which have a large following. Boots Pure Drug provided an interesting feature with a rise on the week from 43s. 9d. to 48s., the further gain being attributed to buying on the view now current in some quarters of the market that, although the long-talked-of scrip bonus may not be forthcoming yet awhile, the impending results, besides maintaining the cash distribution, may also announce an issue of shares on terms involving a bonus.

Beechams Pills deferred shares have been active around the higher level of 36s. 3d., market hopes in this connection being that the dividend may be raised to 70 per cent. and that the distribution of an annual scrip bonus may be continued. On the other hand, Eno Proprietaries were dull at 5s. 1½d., owing to fears of a lower dividend in view of the fact that there was a "cut" in the interim payment in November last. Market estimates of the total for the year range from 8 per cent. to 10 per cent. Sangers, market views in connection with which were mentioned last week, were better at 21s. 1½d., which compares with 20s. 1½d. a week ago. Timothy Whites and Taylors have improved from 26s. to 26s. 3d. Greeff Chemicals Holdings 5s. units had a steady appearance at 6s. 3d., while Monsanto Chemicals 5½ per cent. preference were again 22s. 6d. British Glues are unchanged at 5s. 7½d. at the time of writing. British Industrial Plastics 2s. shares have been active at 2s. 3d., there being reports in the market that the company's business is continuing to show steady growth. On the other hand, Erinoid were dull at 3s. 6d., awaiting the interim dividend announcement. Lever and Unilever rose to 37s. 9d.

Imperial Chemical changed hands actively, as usual, and at 31s. 10½d. have improved further in price, awaiting the annual meeting on 21st April. Eaglescliffe Chemical 6 per cent. preference shares, which were issued recently, and are at present 10s. paid, transferred between 9s. 6d. and 10s. 6d. The shares will become fully paid on 30th April. Fison, Packard and Prentice were moderately higher at 33s. 1½d., but at the time of writing Cooper McDougall and Robertson are unchanged at 28s. 9d. Cerebos were firm and higher on balance, awaiting the dividend announcement of this successful company. Reckitt and Sons ordinary were well maintained at 103s., as were J. and J. Colman ordinary at 74s. As was expected in the market, the latter company is again bringing its distribution up to 16 per cent.

Imperial Smelting was more active at 10s. 6d. on the hope that the Budget may possibly refer to an increase in the zinc duty, although this does not appear to be expected in responsible quarters. United Glass Bottle have moved up from 48s. 9d. to 51s. under the influence of the statements at the recent meeting, which indicated that British Bottles, Ltd., the important subsidiary, did not pass on all its profits to the controlling company.

Consett Iron and various other iron and steel shares responded to more hopeful views of dividend prospects. Stewarts and Lloyds were strong at 35s. 10½d.

Associated Portland Cement were active and rose further from 75s. to 81s. 3d. Anglo-Iranian and other prominent oil shares responded to the better tendency of markets, but, as in other directions, earlier gains were not fully held.